



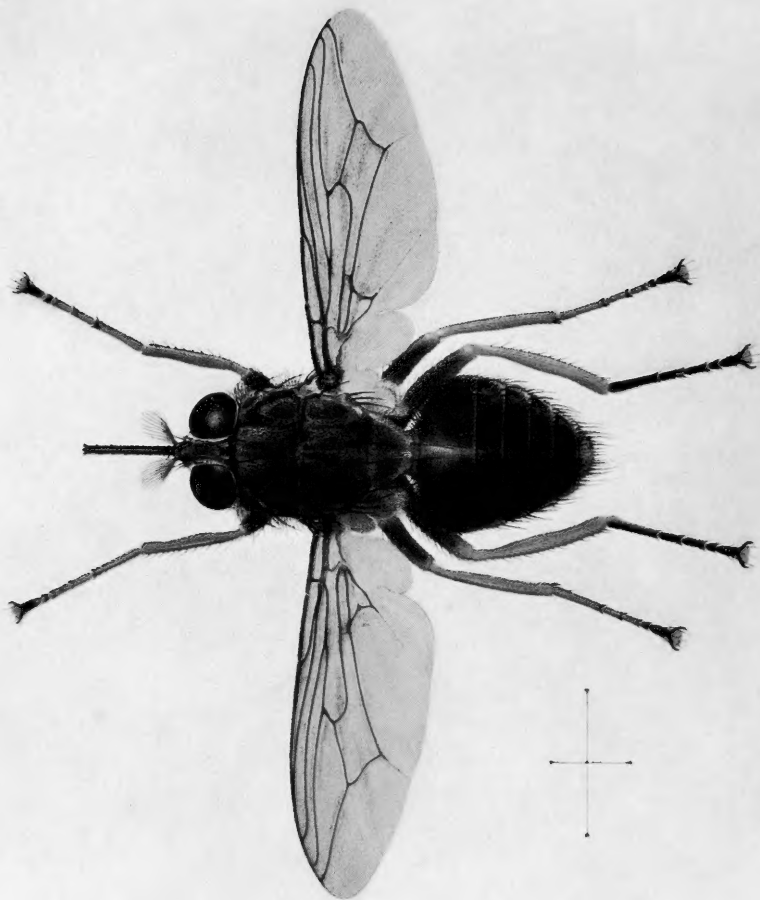


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PL. I. GLOSSINA
PALPALIS, Rob.
Desv. ♂ ($\times 6$).



A. J. ENGEL TERZI AD NAT. DEL.

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A HANDBOOK
OF THE
TSETSE-FLIES
[GENUS GLOSSINA]

BY
ERNEST EDWARD AUSTEN

ASSISTANT IN THE DEPARTMENT OF ZOOLOGY
BRITISH MUSEUM (NATURAL HISTORY)

WITH TEN COLOURED PLATES AND ILLUSTRATIONS
IN THE TEXT
BY A. J. ENGEL TERZI



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PREFACE.

A PRACTICAL and detailed knowledge of Tsetse-flies is essential for the material progress of a large part of Africa. How large a part is affected by these formidable insect-pests may be estimated by a glance at the Map which appears in this "Handbook."

In order to settle the grave questions which are connected with the transmission of certain insect-borne diseases, it is not sufficient to know that a given insect belongs to the genus *Glossina*—or, in other words, is a Tsetse-fly—but, as indicated by the author in his Introduction, it may be of vital importance to know with certainty the species to which it belongs.

The study of the Tsetse-flies was greatly advanced by the appearance of Mr. Austen's "Monograph of the Tsetse-Flies," which was published by order of the Trustees of the British Museum in 1903. That work has been out of print for some time, and moreover our knowledge of the genus *Glossina* has considerably increased during the interval. The present "Handbook," by the same author, is an attempt to bring the subject up to date; and it is hoped that it has been drawn up in such a way that, in addition to being a reliable contribution to systematic literature, it will prove useful to medical officers and others engaged in the struggle with disease in Africa.

SIDNEY F. HARMER,
Keeper of Zoology.

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, S.W.
March 18th, 1911.



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Map of Africa south of the Sahara, illustrating the distribution of *Glossina* *facing page 8*

NOTE.—The crossed lines indicate the natural size (length and wing-expanse); the vertical line includes the palpi.

Students who are not trained entomologists sometimes find it difficult to realise the natural size and appearance of an insect from a greatly enlarged figure. By viewing such a figure through a pocket lens, held at a distance from the object considerably greater than the focal length for magnification, and also at a distance from the eye, there can be obtained a *reduced* image of the illustration, which can be made to approximate very closely to the natural size of the insect. The desired result will be facilitated if the length of the cross-line indicating the wing expanse, and that of the line representing the length of the fly, be first compared with the diameter of the lens; before being examined in this way, a figure should, of course, be inverted.

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INTRODUCTION.

THE insects described and illustrated in the following pages are of vital importance to the prosperity and future development of Tropical Africa. Until quite lately it was considered by those best qualified to form an opinion that Sleeping Sickness is disseminated solely by the species of Tsetse-fly known as *Glossina palpalis*. The recent occurrence, however, of a number of isolated cases of the disease in the Nyasaland Protectorate and the valley of the Luangwa River, North-Eastern Rhodesia, in both of which localities *Glossina palpalis* is believed to be non-existent, has caused grave suspicion to attach to two other species of Tsetse (*Glossina morsitans* and *G. brevipalpis*). Experts have for some time been aware that Nagana or other closely similar trypanosomiasis of domestic animals can be conveyed by the bites of several species of Tsetse-flies, including *Glossina palpalis*, and the possibility that *Trypanosoma gambiense*, the parasite of human trypanosomiasis, or Sleeping Sickness, may have more than one insect vector naturally suggested itself; yet, until the alarming discovery of the cases referred to, the results of observation appeared to negative any such conclusion. Whether, as certain authorities believe, the Rhodesian parasite is specifically distinct from *Trypanosoma gambiense* or not, it is here only necessary to point out that should such a differentiation in the actual causative agent of the disease be established, the probability that more than one species of *Glossina* is acting as a carrier would thereby be increased. In any case, it is obviously desirable that Colonial Medical Officers and other officials in Tropical Africa should have a ready means of recognising and accurately identifying the Tsetse-flies found in their districts, and it is hoped that the present volume may serve as a means to this end.

In the eight years that have elapsed since the publication of the author's "Monograph of the Tsetse-Flies" our knowledge of these insects, thanks to the researches of Sir David Bruce and his collaborators, Professors Minchin and Newstead, Dr. J. L. Todd, the late Dr. Koch, Drs. Stuhlmann and Kleine, Mons. E. Roubaud, and others, has enormously increased. The Monograph, which is now out of print, contained descriptions and illustrations

of seven species. In the following pages that number is increased to fifteen, including two species here described for the first time.

At the time of the publication of the Monograph the connection of *Glossina palpalis* with Sleeping Sickness had not yet been established, and practically nothing was known as to the habits of that particular Tsetse, upon which a host of observers have since concentrated their attention. Thus, although much space in the Monograph was devoted to the subject of "Bionomics," the majority of the statements given referred to *Glossina morsitans*, the pest of the elephant-hunter and pioneer in South Africa, and the species to which the name "Tsetse" was originally applied. No observations worth mentioning on any other species had in fact been made, and what was known as to *Glossina morsitans* had consequently to do duty for the genus *Glossina* as a whole. We now know that haunts and habits are not necessarily the same in all species, and in the present work a summary of the ascertained facts with regard to "Bionomics" is given under the heading of each species.* It will be seen that in the case of certain species much—in some instances everything—has yet to be learnt. There is thus a wide field for further observation, and it need hardly be said that information from those in a position to supply it will gladly be received. At the present time a sub-committee appointed by the Entomological Research Committee (Tropical Africa) is endeavouring, by means of series of carefully framed questions addressed to reliable observers on the spot, to obtain accurate information as to the habits, dependence or otherwise upon big game, etc., of *Glossina morsitans*, matters about which much uncertainty still exists. When all the replies that it is hoped to receive in this way are collated, a mass of useful knowledge should be acquired concerning a species which is one of the greatest enemies of the stock-breeder in Rhodesia and elsewhere.

In conclusion, it need only be added that prophylactic measures in the fight against Tsetse-flies, to which attention is now being devoted, are not referred to, since they are beyond the scope of this work.

ERNEST E. AUSTEN.

BRITISH MUSEUM (NATURAL HISTORY),
LONDON, S.W.

March 16th, 1911.

* Except *G. palpalis*—see page 27.

A

HANDBOOK OF THE TSETSE-FLIES.

(GENUS GLOSSINA.)

CHAPTER I.

THE GENERAL CHARACTERISTICS AND DISTRIBUTION OF TSETSE-FLIES (GENUS GLOSSINA).

General Characters of Tsetse-flies: how to distinguish them from other flies. The insects forming the subject of this volume may be described as ordinary-looking dark brown, blackish, yellowish-brown, or yellowish flies, varying in length from about 6 or 8 millimetres, as in the case of *Glossina tachinoides*, to as much as 13 or 13·5 millimetres in that of *G. brevipalpis* or *longipennis*,* with a prominent proboscis in all species. The hinder half of the body, or abdomen, in the species belonging to the *Glossina morsitans* group and in *G. tachinoides* is of a paler colour and marked with sharply defined dark brown bands, which are interrupted on the middle line; the abdomen, however, is invisible when the insect is at rest, as it is then concealed by the wings. The sexes of Tsetse-flies can readily be distinguished when specimens can be examined, since in the male the external genitalia form a conspicuous knob-like protuberance (hypopygium) beneath the end of the abdomen (see Figs. 14 and 15, pp. 50, 51), which is absent in the female.

* These measurements are only from the head to the end of the body and are exclusive of the proboscis and palpi, which project horizontally in front of the head. In the crossed lines on the coloured plates, however, the vertical line indicates the average length of the whole insect, *including the proboscis*, the transverse line showing the wing-expanse.

2 DISTINCTIVE CHARACTERS OF TSETSE-FLIES.

It is probable that only those who have suffered from the attacks of Tsetse-flies can recognise them when on the wing, but *in the resting position* their identification is easy. In this attitude they can be distinguished from all other blood-sucking Diptera, with which confusion could possibly take place (especially from those belonging to the genera *Stomoxys*, Fig. 2, and *Haematopota*, Fig. 3, which are most likely to be mistaken for them), by the fact that the *wings lie closed flat over one another down the back*,

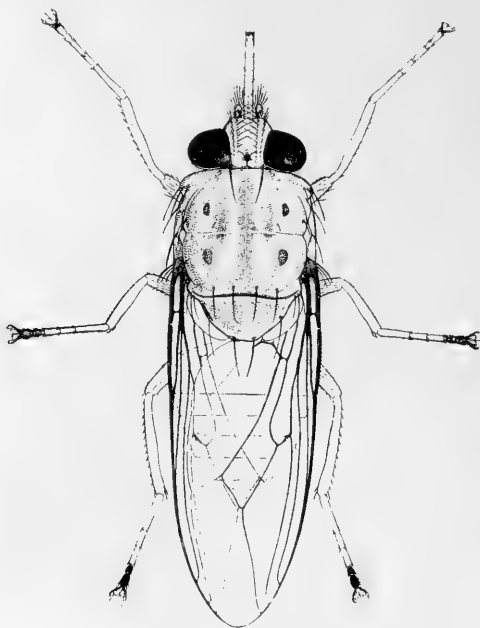


Fig. 1.

A Tsetse-fly, *Glossina longipennis*, Corti (Somaliland), in resting attitude, showing the position of the wings. (Partly diagrammatic. $\times 4$.)

like the blades of a pair of scissors, while the *proboscis* (i.e. the proboscis ensheathed in the palpi) *projects horizontally in front of the head* (see Fig. 1).

Apart from the prominent proboscis and the mode of carrying the wings when at rest, there is nothing in any way remarkable or striking about the appearance of a Tsetse, and the descriptions of most African travellers emphasise this fact. As already mentioned, species of *Stomoxys* and *Haematopota* are most likely to be mistaken for *Glossina*, and apart from these confusion

can hardly take place. The members of both genera are greedy blood-suckers, and often torment human beings and domestic animals very greatly. Although *Stomoxys* also has a prominent proboscis, it is not ensheathed in the palpi, and is consequently much more slender in appearance than the proboscis of *Glossina*. The species of the former genus are usually greyish, greyish-black, or blackish flies, and since their wings when in the resting position, instead of closing one over the other, diverge at an angle (see Fig. 2), like those of *Musca domestica*, it is easy to distinguish them from Tsetse-flies. *Haematopota*, on the other hand, a genus of small horse-flies (Family Tabanidae) abundantly represented in Tropical Africa, resembles *Glossina* somewhat closely when at rest. Although the species of this genus are of much the same elongate shape

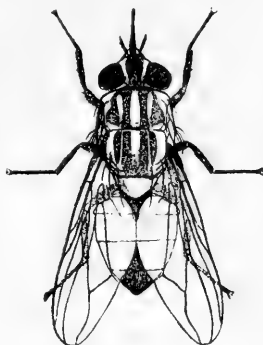


Fig. 2.
Stomoxys calcitrans, L., in resting attitude, showing the position of the wings. (Partly diagrammatic. $\times 4$.)

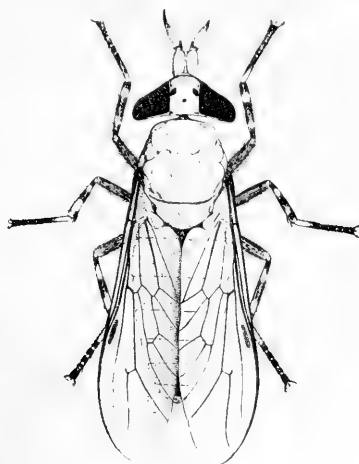


Fig. 3.
Haematopota vittata, Lw. (Tropical Africa), in resting attitude, showing the position of the wings. (Partly diagrammatic. $\times 4$.) The wing markings are omitted.

as Tsetse-flies, their wings in the resting position do not close one over the other, but diverge slightly at the tips and are

also somewhat *tectiform*, i.e. they meet together at the base like the roof of a house (Fig. 3). The antennae, too, afford a further means of distinction. While the antennae of Tsetse-flies, as of all other Muscidae, are drooping, those of *Haematopota* project horizontally in front of the head, and being of some length are readily seen.

In those parts of Africa in which Tsetse-flies occur they are not found everywhere, but are **Where Tsetse-flies are usually found.** *generally* confined to particular tracts, which are known as "Fly-belts," and are often of very limited extent. We are still somewhat in the dark as to the factors that determine the limits of these "belts," but, although Tsetse are undoubtedly dependent upon the blood of vertebrates for their continued existence, all recent evidence goes to show that the most important element is the physical character of the locality, and, probably, its suitability as a breeding-ground. As a general rule it may be said that Tsetse-flies are usually met with in damp, hot localities, either on the borders of rivers or lakes, or at any rate not far from water; this, however, applies more especially to the species belonging to the *Glossina palpalis* group; other Tsetse-flies, especially those of the *Glossina morsitans* group, are often found at a considerable distance from water. Cover in the shape of more or less thick bush or forest, shady trees, or reeds, is essential, and Tsetse-flies are absent from open grass plains.

Reproduction. The mode of reproduction in Tsetse-flies—first discovered by Sir David Bruce, during his classical investigations in Zululand in 1895-96—is extremely remarkable, since, instead of laying eggs as do the majority of Diptera, the pregnant female produces at each birth a *single full-grown larva*, which, while retained within the oviduct of the mother, is nourished by the secretion of special glands, and on being born crawls away into some hiding place and immediately changes into a pupa. Observations show that, under normal conditions as regards temperature and humidity, the extrusion of larvae takes place at intervals of from about eight to eleven days. The Tsetse-fly *larva* is a yellowish, footless maggot, nearly as large as the abdomen of the mother, with a shagreen-like integument, and the anal extremity (twelfth segment) produced into a pair of large, black, granular prominences (the tumid lips), separated by a pit-shaped depression containing the stigmata or respiratory apertures.

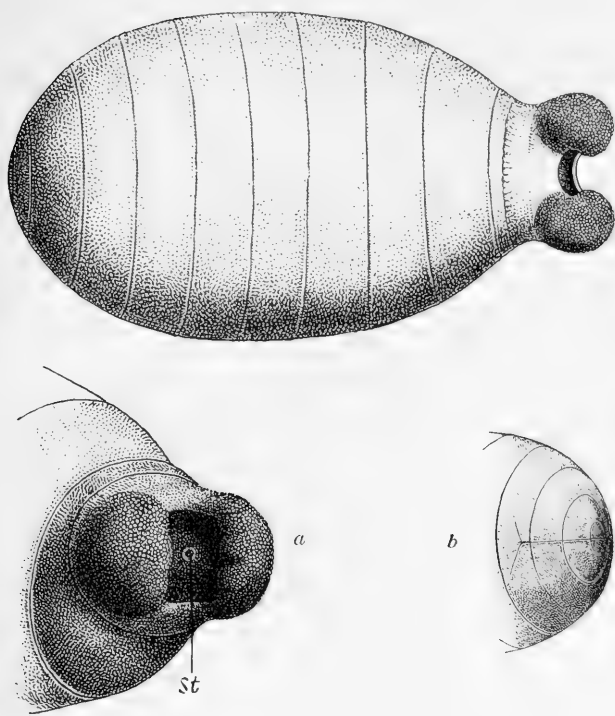


Fig. 4.

Pupa of *Glossina pallidipes*, Austen, dorsal aspect ($\times 12$): *a*, posterior extremity, showing pit and (*st*) right larval stigma ($\times 24$); *b*, anterior extremity, showing longitudinal seam, which opens to permit the escape of the fly ($\times 8$).



Fig. 5.

Pupae of six species of Tsetse-flies, dorsal aspect, natural size.—A, *G. brevipalpis*, Newst.; B, *G. fusca*, Walk. (cephalic (lower) extremity missing); C, *G. morsitans*, Westw.; D, *G. pallidipes*, Austen; E, *G. tachinoides*, Westw.; F, *G. palpalis*, Rob.-Desv. (From photographs of actual specimens.)

The shape and appearance of the *pupa* * will, it is hoped, be readily understood from Figs. 4, 5, and 6. Tsetse-fly pupae are dark brown or clove-brown in colour, with a slight sheen which produces somewhat the effect of the bloom on a black plum. The tumid lips seen in the larva are equally conspicuous in the pupa, and the shape of the notch between them, in conjunction with the size and shape of the lips themselves, affords a valuable means of identifying and distinguishing pupae belonging to different species (see Fig. 6).

**Geographical
Distribution.**

Although, since the discovery of *Glossina tachinoides*, Westw., in Southern Arabia,† the generalisation that existing Tsetse-flies are confined to Africa no longer holds good, it is nevertheless true that the genus *Glossina* at the present day occurs only in the Ethiopian Region, inasmuch as the southern portion of Arabia belongs zoo-geographically to the region in question.‡ In the African continent Tsetse-flies have a very wide distribution in the tropical and sub-tropical zones. Roughly speaking, so far as our present knowledge goes, the northern boundary of the genus may be represented by a line drawn from the mouth of the Senegal River across the middle of Lake Chad to the Nile, just south of the twelfth parallel of north latitude, and thence to the east coast at about 4° N. ; while its southern limit may similarly be shown by tracing a line from the mouth of the Cunene River, the southern boundary of Angola, to the north-eastern extremity of St. Lucia Lake, in Zululand. Within this area Tsetse-flies, as already explained, are not found continuously, but are restricted to "belts" or "patches" of forest, bush, banana-plantation, or even reeds. The accompanying map must not be regarded as affording anything more than an *approximate* idea of the distribution of *Glossina*. Since the necessary cover is mainly found in the valleys of rivers and watercourses, and on the shores of lakes, it is chiefly the river-systems that are marked on the map. In a map on so small a scale it is, however, almost impossible to convey any idea of the actual extent of fly-belts or fly-areas. Since it is practically certain that *Glossina palpalis*

* What is seen is really the *puparium*, or chitinous pupa-case, consisting of the hardened and contracted skin of the adult larva; the true, soft-bodied *pupa* lies within this protecting envelope. Puparia of this character are invariably found in the Muscidae, and other families of Diptera belonging to the same division of the Order.

† Cf. p. 41.

‡ Cf. p. 41, note †.



A



B



C



D



E

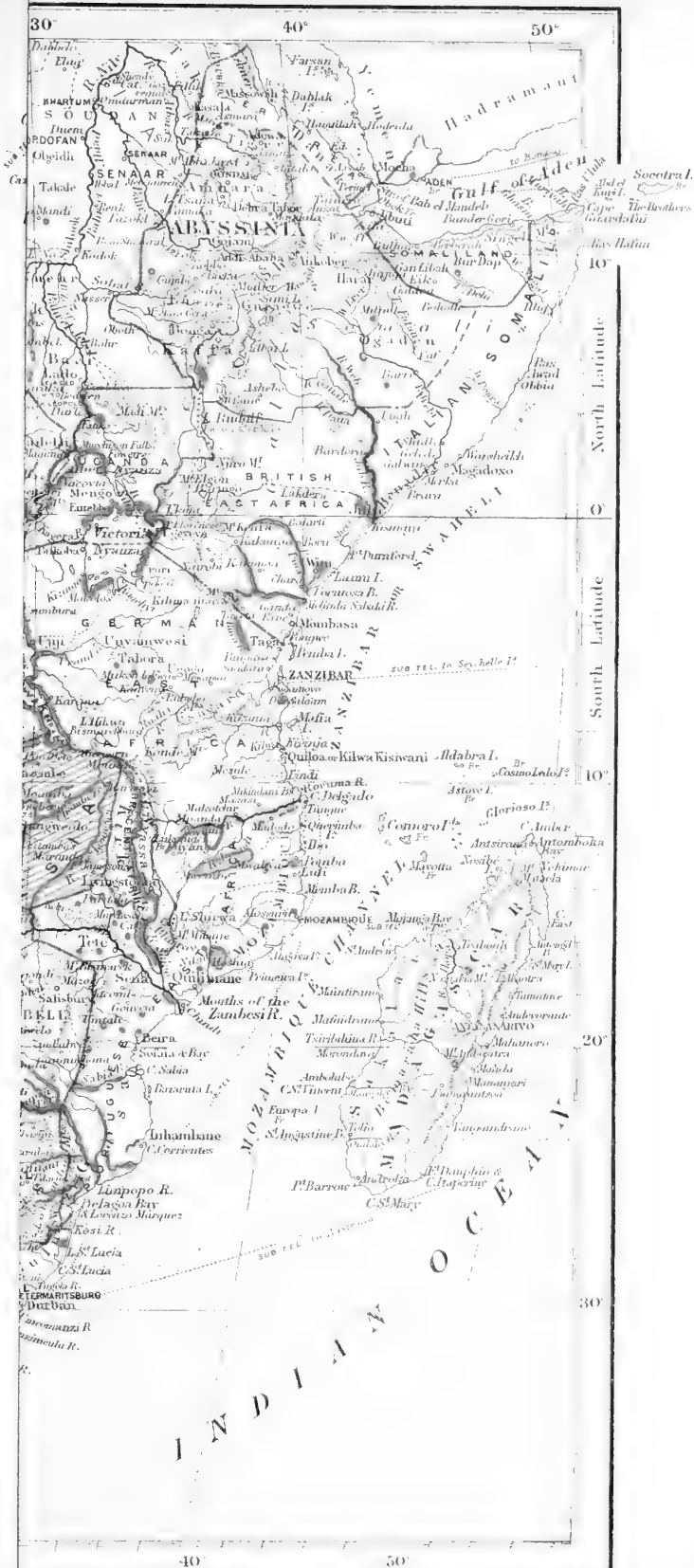


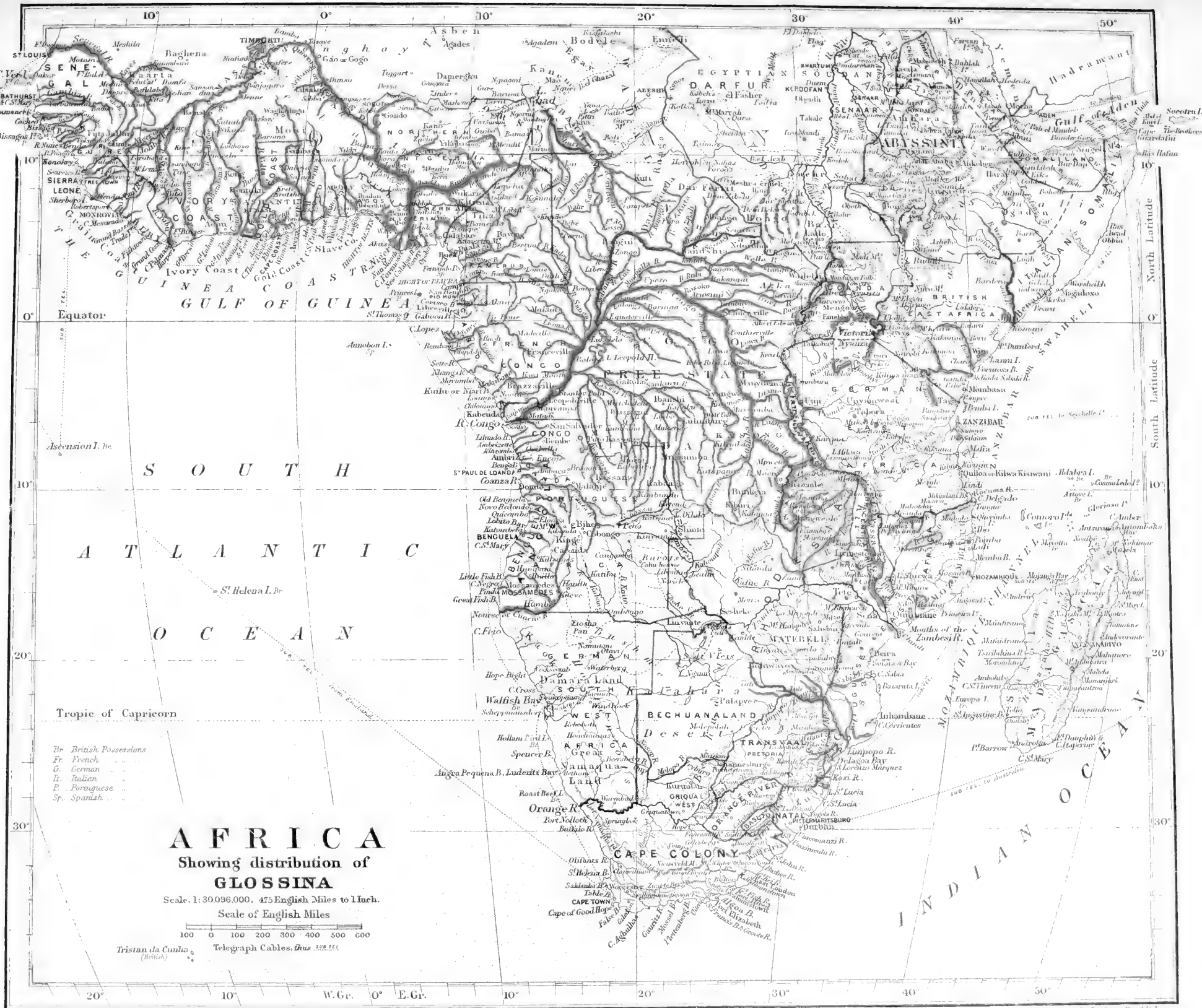
F

Fig. 6.

Pupae of six species of Tsetse-flies, dorsal aspect, $\times 6$: the same specimens as those represented in Fig. 5.—A, *G. brevipalpis*, Newst.; B, *G. fusca*, Walk. (cephalic (lower) extremity missing); C, *G. morsitans*, Westw.; D, *G. pallidipes*, Austen; E, *G. tachinoides*, Westw.; F, *G. palpalis*, Rob.-Desv. (From enlargements of photographs of actual specimens.)

occurs, for instance, throughout the Congo-basin, the Congo and its affluents are coloured red ; but, for the reasons already stated—apart from the fact that a species of *Glossina* is not necessarily to be found all through the year at a spot at which it may be known to exist—it must not be imagined that *G. palpalis* occurs continuously over the whole of the Congo River system. The present map should only be considered as indicating, very roughly, how large a portion of Africa is included within the area of distribution of the genus *Glossina*, and consequently exposed to the contingent perils.





Br British Possessions
Fr French
G German
I Italian
P Portuguese
Sp Spanish

AFRICA

Showing distribution of
GLOSSINA

Scale, 1:30,096,000. 475 English Miles to 1 inch.

Scale of English Miles

100 0 100 200 300 400 500 600

Tristan da Cunha (British)
Telegraph Cables, thus

CHAPTER II.

THE EXTERNAL CHARACTERS OF THE GENUS
GLOSSINA.

GENUS GLOSSINA.

Glossina, Wiedemann, *Aussereuropäische zweiflügelige Insekten*, Zweiter Theil, pp. 253, 254 (1830). **Nemorhina**, Robineau-Desvoidy, *Essai sur les Myodaires (Mémoires présentés . . . à l'Académie Royale des Sciences de l'Institut de France . . . Sciences Mathématiques et Physiques. Tome Deuxième)*, pp. 389, 390 (1830).

Narrow-bodied, elongate, dark brown, blackish, yellowish-brown, or yellowish flies belonging to the Family Muscidae, ranging in size from about 6 or 8 mm. in the case of Glossina tachinoides, Westw., to as much as 13 or 13.5 mm.* in that of a large female of G. brevipalpis, Newst., or longipennis, Corti; recognisable when alive and at rest by the wings being closed flat one over the other above the abdomen (beyond which they project considerably), instead of divaricate (as in the case of Stomoxys) or tectiform (as in Haematopota), and by the proboscis (i.e. proboscis ensheathed in the palpi), projecting horizontally in front of the head; palpi, as seen in the natural position, extending slightly beyond the proboscis, their inner sides grooved so as to form a sheath for the latter, to which in life they are applied so closely as entirely to conceal it; base of proboscis suddenly expanded beneath into a large onion-shaped bulb.*

Head rather narrower than the thorax; eyes separate in both sexes; width of the front at the vertex in the ♂ ranging from one-third to rather more than one-half of that of the eye at its widest part, and in the ♀ from one-half to rather more than

* Length measured from the face to the end of the abdomen, excluding the proboscis and wings.

one-half of the width of the eye; vertex slightly depressed below the level of the eyes; facial pit deep, undivided by a septum, extending to the oral margin, which is up-turned and prominent; curved suture (*Bogennahrt* of Brauer and von Bergenstamm) ending in a pit above the lower margin of the eye, the pit on each side being prolonged into a more or less marked, shallow depression (*transverse impression* of Hough) separating the face from the jowls;* the latter narrow in front, broad and rounded posteriorly, crossed by a line of black bristles which passes on to the occipital surface of the head, and is continued as the series of small bristles marking off the posterior orbits; jowls clothed with fine hair behind the line of black bristles just mentioned, in front, like the face, bare; vibrissal ridges sharp and narrow, not broadening out below as in *Stomoxys*, *Haematobia*, and other genera of Muscinae, ciliated to the level of half the length of the third joint of the antennae, or higher; vibrissae small, fine, no elongated or conspicuous vibrissa even on the vibrissal angle, which is widely separated from the oral margin. Under side of the roof of the buccal cavity with two large, dark brown, strongly chitinised patches, very conspicuous in the majority of species when the head is viewed from below. Eyes bare, in both sexes the facets in front towards the inner margin conspicuously larger than those behind. First two joints of the antennae small, the third long, nearly reaching the oral margin, concave in front, the tip being produced into a prominent forwardly-directed angle. On the inside of the third joint of the antenna near the base a minute though well-marked pore can usually be distinguished, constituting the orifice of a sense-organ (see Fig. 8).† Arista three-jointed, though first two joints very small, and first joint visible only when the antenna is removed and examined under the microscope; terminal joint remarkably broad throughout its length, flat, tapering somewhat to the tip, but far from being reduced distally to the proportions of a fine hair, as in the case of the arista of *Stomoxys*; feathered on the upper side alone

* I follow Mr. G. H. Verrall ("British Flies, Syrphidae, etc.," 1901) in using the term *jowl* for the part of the head beneath the eyes (*Backe*, of German authors), separated from the *face* (German, *Wange*) by the curved suture or its prolongation. In 1898 Hough ("Proc. Acad. Nat. Sc., Philadelphia," 1898, p. 168) proposed the terms *gena* and *bucca* for *Wange* and *Backe* respectively.

† Dr. Stuhlmann, writing of *G. brevialpis*, Newst., calls this an "auditory" organ. If the antenna be mounted in glycerine and examined under a low power, the sense-organ has the appearance of an oval sac.

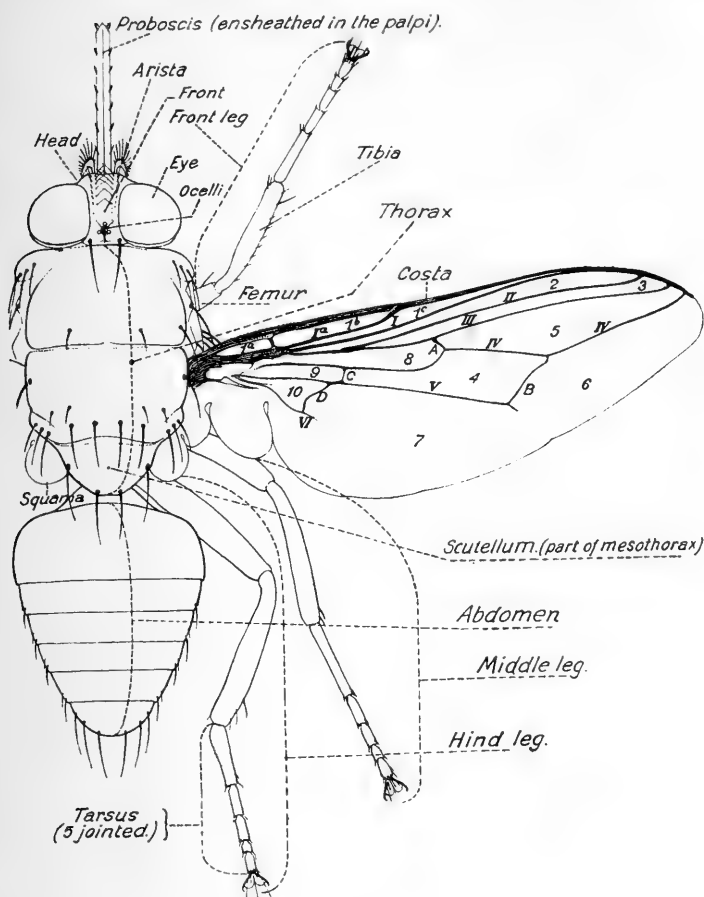


Fig. 7.

Diagram showing nomenclature of external characters of *Glossina*, used in description.

VEINS AND CELLS IN THE WING.

Longitudinal Veins.		Transverse Veins.		Cells.	
I ^a .	Auxiliary vein.	A.	Anterior transverse vein.	1 ^a , 1 ^b , 1 ^c .	First, second, and third costal cells.
I.	First longitudinal vein.	B.	Posterior " "	2.	Marginal cell.
II.	Second " "	C.	Anterior basal " "	3.	Sub-marginal cell.
III.	Third " "	D.	Posterior " "	4.	Discal cell.
IV.	Fourth " "			5, 6, 7.	First, second, and third posterior cells.
V.	Fifth " "			8.	Anterior basal cell.
VI.	Sixth " "			9.	Posterior " "
				10.	Anal cell.

NOTE.—The *frontal stripe* is the strip of coloured integument running down the centre of the *front* (the space between the eyes), from the ocelli to the base of the antennae.

(including the tip) with from seventeen to twenty-nine fine, curving, *branched* hairs (see Fig. 8).* Proboscis projecting as already described and, with the palpi, curving slightly downwards; reddish-brown below, glistening yellowish-white above nearly to the tip, which is marked off by a slight constriction

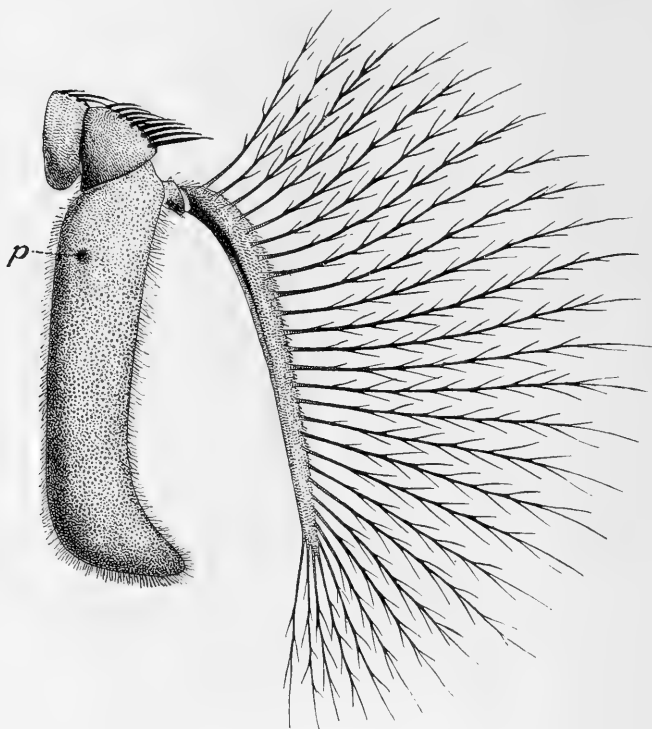


Fig. 8.

Left antenna of *Glossina pallidipes*, Austen, ♂, from the inner side ($\times 60$); the very minute proximal joint of the arista is not visible in this view; *p*, aperture of sense organ on third joint of antenna. (The *arista* is the process—really the distal extremity of the antenna—bearing the branched hairs.)

and exhibits beneath a tiny but conspicuous black spot; the bulbous base of the proboscis is enwrapped posteriorly with a fold of skin forming the hind wall of the buccal cavity. Palpi

* The number of these hairs is usually about twenty-two or twenty-three, but sometimes there are not more than seventeen or eighteen, while in other cases there may be as many as twenty-eight or twenty-nine; the numbers on each arista may even be unequal in the same specimen. The last one or two hairs (at the tip of the arista) are usually bare.

rod-like, of the same width throughout, neither swollen nor tapering towards the tips, clothed with short black hairs and minute bristles, a row of some eight to thirteen tiny erect black bristles running along the upper margin, the individual bristles separated by something like regular intervals, and a similar row running along the outside on the basal two-thirds of the palpus; two somewhat longer and stouter bristles * directed downwards and forwards on the under and outer side immediately before the tip. (For the bristles of the head see below under "Chaetotaxy—Cephalic Bristles.")

Thorax quadrate, flattened or only very slightly arched above, to the naked eye appearing bare, but in reality sparsely clothed with minute black hairs; the macrochaetae likewise few in number, arranged as described below under "Chaetotaxy." Transverse suture well marked, forming a groove. Scutellum flattened, with a pale impressed median line, and a darker patch on each side. Markings of the thorax, when completely developed, as shown in Plates I and II (*Glossina palpalis*, Rob.-Desv., and *caliginea*, Austen), but in some species very inconspicuous; if distinguishable at all from the ground colour, taking the shape of grey or brown blotches, streaks, or spots.

Abdomen also flattened, tapering to the apex; dorsum of the second segment with a pair of, more or less distinct, longitudinal grooves or impressed lines, one on each side of the middle line, converging towards the hind border of the segment and thus enclosing a more or less lanceolate area, which is sometimes paler in colour than the remainder of the segment; dorsum of the abdomen thinly clothed with minute and exceedingly short, appressed black hairs, which on the basal angles of the second segment become longer and erect, and on the hind margins of the following segments, from the third to the fifth, take the shape of fine black bristle-like hairs, especially on the apical angles, where they are longest and stoutest; hind margin of the sixth segment, and also that of the seventh in the female, with a complete row of longer bristle-like hairs; seventh segment in the male with an especially conspicuous transverse row of black bristle-like hairs or fine bristles on each side of the median line beyond the middle. *The male hypopygium* † *highly characteristic in shape* (see Figs. 14 and 15, pp. 50, 51), *more or less oval and tumid*, its longer axis lying

* In dried specimens these are often missing—one at least is frequently indistinguishable.

† The modified eighth abdominal segment, to the inner and concealed surface of which the male genital appendages are attached.

in the antero-posterior direction, *with a vulviform median groove* (the anus) *running from the anterior margin to beyond the middle*. Ventral surface of the sixth segment in the male, immediately in front of the hypopygium, exhibiting on each side of the middle line a chitinated plate, roughly oval in shape and bearing a patch of close-set, erect or recurved, minute black hairs; * ventral surface of the remainder of the sixth segment and that of the remaining segments except the first in the male, and of all the segments except the first in the female, membranous.

Legs simple, rather long, claws longer and pulvilli somewhat larger in the male than in the female. Front femora with a row of bristle-like hairs above and below, and (except in the case of *G. morsitans* †) on the posterior surface with a median row of minute black spines. Middle and posterior femora with a row of bristle-like hairs on the basal half of the anterior surface, near the upper margin, and with a shorter row of similar hairs, or short bristles as the case may be, at the base beneath. Middle femora with a solitary bristle, usually conspicuous in the larger species, on the upper side near the tip. Tibiae with a well-marked ridge, edged with a row of closely-set minute black spines, running down the outer surface, so that they, especially the front and hind pair, usually have the appearance of being somewhat flattened from side to side; the middle tibiae have a second row of still more minute spines in advance of that just mentioned, the space between, owing to the presence of the ridge, having the appearance of being excavated. Tibiae also with a row of short fine hairs or bristle-like hairs running down the outer side, and sometimes with one or two short bristles close to the apex on that side, otherwise, with the exception of the usual apical spines, entirely devoid of isolated bristles or bristle-like hairs. On the three basal joints of the front and middle tarsi three rows of minute black spines similar to those on the tibiae; on the basal joints of the hind tarsi they are less distinct, but apparently two rows are present.

Wings with an *absolutely unique venation* (see Fig. 7), which, apart from all other characters, will at once serve to distinguish a specimen of the genus. The most striking peculiarity is the

* These plates, the function of which obviously is to assist in holding the female during copulation, may be termed the *hectors* (Greek ἔκτωρ, holding fast); they sometimes furnish useful characters for the distinction of species.

† In the case of *G. longipennis*, too, the row appears to be broken up into a double line and is consequently barely distinguishable.

course of the *fourth longitudinal vein*. The anterior basal transverse vein, at the base of the discal cell, is very short, and the portion of the fourth longitudinal vein before the anterior (small) transverse vein is bent downwards in such a way as greatly to narrow the basal half of the discal cell, the width of the distal portion of the anterior basal cell being correspondingly increased; the fourth vein bends abruptly upwards to the point of contact with the anterior transverse vein, where it forms with itself what is practically a right angle; from this point it again runs obliquely downwards, and is once more bent upwards at the exact point of contact with the posterior transverse vein, ultimately reaching the margin of the wing some distance before the apex. The first posterior cell is open, but its distal portion is narrow and much drawn out. The third longitudinal vein is very close to the second, and shows a marked approximation to the costa, the sub-marginal cell being correspondingly narrow; the third costal cell is considerably elongated; the second, third, and fourth longitudinal veins all turn upwards at the tips, and *the anterior transverse vein is very oblique*; the sixth longitudinal vein becomes obsolete soon after the anal cell, though in clear, unchitinised form it can still be traced nearly to the margin of the wing. Posterior basal transverse vein, closing the anal cell, angulate in the middle, so that the distal angles of the cell are acute. Posterior transverse vein slightly curved, bent up somewhat abruptly to meet the fourth longitudinal. Wings varying in colour according to the species from light drab to sepia-brown; membrane of the wing rilled.*

CHAETOTAXY OF *GLOSSINA*.

Cephalic Bristles.—One pair of *vertical* bristles of large size (the largest and most conspicuous bristles on the head); on the occipital region no trace of the pair of bristles termed by Hough (Proc. Acad. Nat. Sc. Philad. 1898, p. 166) the *occipito-central*; *greater ocellar* bristles (ocellar pair of Osten Sacken) small; *post-vertical* pair not differentiated in size from the remainder of the lesser ocellar bristles; *frontal* bristles largest below (trans-

* Cf. Garry de N. Hough, M.D., "Some Muscinae of North America," "Biological Bulletin," Vol. I (1899), p. 20, note 1:—"These rills are very fine grooves in the surface of the wing, which run in a sort of radiate manner towards the border. They are very numerous. A rilled wing denotes a higher stage of development, a more recent form, than an unrilled wing."

frontal group of Hough, *loc. cit.*); *orbital* bristles absent in both sexes; *vibrissal angle* (separated by a well-marked and rather wide interval from the oral margin) without a large and conspicuous vibrissa; *vibrissal ridges* ciliated to a point on a level with or rather above the middle of the third joint of the antenna.

Thoracic bristles.—The general arrangement, as can be seen from the accompanying diagrams, is, on each side, as follows:—

Dorsal aspect (Fig. 9).—*Humeral*, from 1 to 3 (sometimes apparently 4), the lowest bristle the largest. *Post-humeral* (intra-humeral of Osten Sacken) absent. *Notopleural* (of Girschner

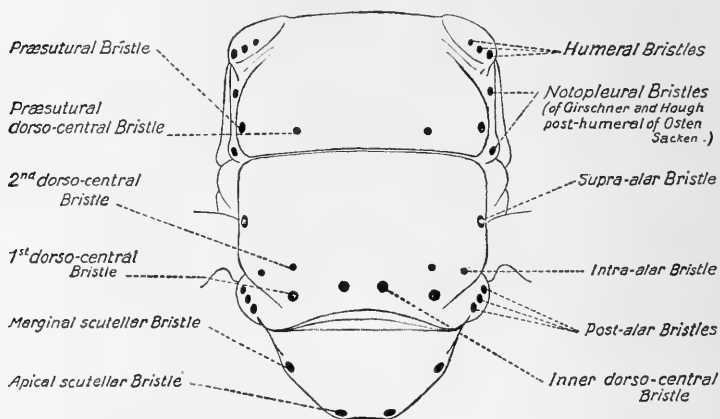


Fig. 9.

Diagram of thoracic chaetotaxy of *Glossina*, dorsal aspect. ($\times 10$.)

and Hough, post-humeral of Osten Sacken), 2. *Praesutural*, 1.* *Supra-alar*, 1. *Intra-alar*, 1, situated just in front of the post-alar callus, on a level with the second dorso-central. *Post-alar*, 3, the foremost somewhat smaller than the other two, and placed directly above the alar frenum. *Dorso-central*, 3, two near together, close to the hind margin of the dorsum, and one immediately in front of the suture; the latter bristle may be termed the *praesutural dorso-central*. *Inner dorso-central*, 1, near the hind margin of the thorax. *Scutellar*, 2, one marginal (near the basal angle), the other apical; additional scutellar bristles are occasionally found.

The relative size of the various bristles enumerated above is

* Often small and difficult to distinguish in *G. palpalis*.

roughly indicated in the diagrams by the size of the dots. Generally speaking the largest bristles are the lowest humeral, the notopleural, supra-alar, post-alar, the bristles of the transverse row formed by the first and inner dorso-centrals, and the marginal and apical scutellar bristles.

Pleural aspect (Fig. 10).—*Prothoracic*, 1. *Stigmatic* (cf. Becker, Berl. Ent. Z. xxxix (1894), p. 83), 1. *Mesopleural*, a

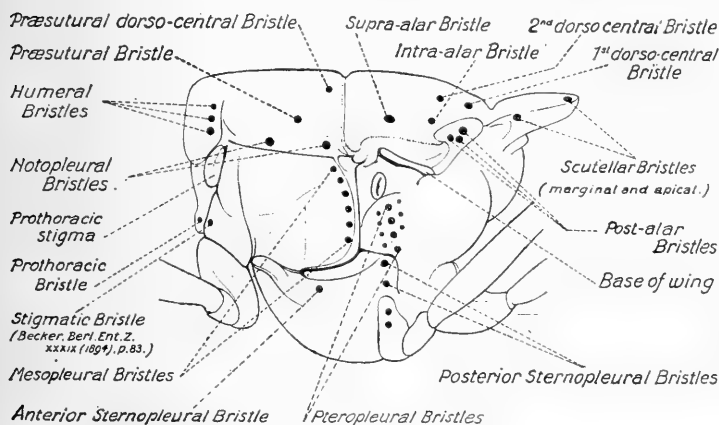


Fig. 10.

Diagram of thoracic chaetotaxy of *Glossina*, pleural aspect. (x 10.)

vertical row of about 6 along the posterior edge, with smaller bristles in between. *Pteropleural*,* a vertical row of usually 3, with smaller bristles on either side. *Sternopleural*, 3,—1 anterior, and 2 posterior: below, a conspicuous row of bristles in front of the middle coxae. *Hypopleural*, none.

* *Pteropleural* bristles seem to be entirely wanting in *Stomoxys*, *Haematobia*, and other genera of the Muscinae.

CHAPTER III.

THE FOUR GROUPS INTO WHICH TSETSE-FLIES
ARE DIVIDED.—TABLES FOR THE DETERMINATION
OF GROUPS AND SPECIES.

IN his recent paper on the male genital appendages*—one of the most valuable contributions to our knowledge of the Tsetse-flies yet published—Mr. Newstead has divided the genus *Glossina* into three groups. In the present work this arrangement is adopted in a somewhat modified form, since *Glossina brevipalpis*, Newst., and its immediate allies are removed from the *Glossina fusca* group, in which they are placed by Mr. Newstead, and formed into a group by themselves. It is believed that this arrangement represents a natural grouping, which will aid the student in the identification of species. The following Tables are based solely upon *external* characters, in the ordinary sense of the term; though of course subordinate in value to those derived from the male genitalia, external characters have been found by experience to be sufficient for the determination of the species recognised in this volume, while they possess the additional advantage of being *present in both sexes*. The Tables here given must not be regarded as anything more than a series of "short cuts" to the determination of species; the characters mentioned are simply those that are most convenient and easily recognisable for this purpose, and it must on no account be imagined that these represent the *only* differences between species. The detailed descriptions in the following chapters are in all cases comparative, and at the end of the account of each species the differences between it and its nearest allies are specially emphasised under the heading "Affinities and

* "A Revision of the Tsetse-Flies (*Glossina*), based on a Study of the Male Genital Armature," by Robert Newstead, M.Sc., A.L.S., etc. (Bulletin of Entomological Research, Vol. II, Part 1, pp. 9-36, Figs. 1-17 (April, 1911).)

Distinctive Characters." An epitome of the diagnostic characters of each species will be found printed in italics at the commencement of the detailed description, which should always be consulted in cases of doubt.

The dichotomic system is employed in the subjoined Tables, which it is hoped will prove readily intelligible after a little practice. In using the Tables, the *Group* to which a specimen or species belongs should of course be determined first.

TABLE FOR THE DETERMINATION OF GROUPS.

- | | |
|--|--|
| <p>1. Hind tarsi entirely dark brown, blackish-brown, or black above (or at least all joints more or less dark; in <i>G. tachinoides</i>, Westw., the extreme tips of the first three joints and the extreme bases of the second and third joints are buff, and a larger or smaller area at base of first joint is also paler than remainder of joint, especially in ♀)</p> <p>Hind tarsi <i>not</i> entirely dark brown, blackish-brown, or black above, but either last two joints alone so coloured, and thus forming a conspicuous contrast with remaining joints, which are entirely pale, or last two joints, viewed from above, conspicuously darker than first two or first three joints</p> | <p>I. <i>Glossina palpalis</i>
Group.</p> <p style="text-align: center;">2</p> <p>II. <i>Glossina morsitans</i>
Group.</p> |
| <p>2. Upper surface of abdomen distinctly banded, <i>i.e.</i> ground colour pale (drab-grey, buff, or ochraceous-buff), marked with very conspicuous, dark brown or clove-brown, transverse bands, interrupted in the median line *</p> | |

* N.B.—The abdomen of *G. tachinoides*, Westw., is banded in this way, but the coloration of the hind tarsi places this species in Group I. Note that in individuals belonging to Group II. (*Glossina morsitans* Group) the inner extremities of the interrupted abdominal bands are often partially obliterated; in such cases, however, the outline of the obliterated portions is usually traceable.

- Upper surface of abdomen not so banded
(*i.e.* abdominal markings not consisting of interrupted dark bands on a pale ground) 3
3. Wings fairly dark (dull sepia-coloured),
palpi (except in *G. tabaniformis*,
Westw.) long and slender III. *Glossina fusca*
Group.
- Wings pale (pale isabella-coloured or
light drab), palpi short IV. *Glossina brevipalpis*
Group.

TABLES FOR THE DETERMINATION OF SPECIES.

I.

GLOSSINA PALPALIS GROUP.*

1. Dorsum of abdomen ochraceous-buff or buff; third and following segments exhibiting sharply defined, dark brown or clove-brown, interrupted, transverse bands *tachinoides*, Westw.
Dorsum of abdomen not so marked..... 2
2. Third joint of antennae pale (cream-buff to ochraceous-buff), clothed with long and fine hair, forming a conspicuous fringe on front and hind margins (*cp.* Fig. 13, p. 36) *pallicera*, Bigot.
Third joint of antennae entirely dark (mouse-grey), except at extreme base on outer side, and without a conspicuous fringe of long and fine hair 3
3. Dorsal surface of abdomen dark sepia-brown; median paler area on second segment broad, and more or less quadrate or irregular in outline; hypopygium† of ♂ buff or ochraceous-buff *caliginea*, Austen.
Dorsal surface of abdomen blackish-brown; median paler area cuneate (*i.e.* triangular in outline); hypopygium of ♂ grey *palpalis*, Rob.-Desv.

* *Glossina fuscipes*, Newst. (see p. 29), which belongs to this Group, is not included in the above Table, since the author has not yet had the opportunity of studying this species.

† See p. 13, note †.

II.

GLOSSINA MORSITANS GROUP.

1. Last two joints of front and middle tarsi with sharply defined, clove-brown or black tips... 2
 Last two joints of front and middle tarsi without sharply defined, clove-brown or black tips (front and middle tarsi either entirely pale or, at most, last two joints of front tarsi faintly brownish at the tips, and last joint and distal half of penultimate joint of middle tarsi light brown—never so dark as to form a sharp contrast with the remaining joints)..... *pallidipes*, Austen.
2. Third joint of antennae with a distinct fringe of fine hair on front margin; dark brown or clove-brown bands on abdominal segments extending close to hind margins (*i.e.* pale ground colour, apart from the median interspace, confined to a very narrow hind border)..... *longipalpis*, Wied.
- Third joint of antennae without a distinct fringe of fine hair on front margin; dark brown or clove-brown bands on abdominal segments not extending close to hind margins *morsitans*, Westw.*

III.

GLOSSINA FUSCA GROUP.

1. Third joint of antennae fringed with fine hair on anterior and posterior margins; fringe on anterior margin conspicuous under a hand-lens magnifying 15 diameters (nominal), when head is viewed in profile 2
- Third joint of antennae with fringe of fine hair on anterior margin so short as to be scarcely noticeable under a hand-lens magnifying 15 diameters (nominal), when head is viewed in profile (longest hairs in fringe in length not exceeding one-sixth of width of third joint); palpi long and slender 3

* The designation *Glossina morsitans*, as used in this book, includes *G. submorsitans*, Newst. As explained on pp. 51–52, the author, provisionally at any rate, is inclined to regard *G. submorsitans*, Newst., as a form or race of *G. morsitans*, Westw., rather than as a distinct species.

2. Longest hairs in fringe on front margin of third joint of antennae, in length equal to from one-fourth to one-third (not exceeding one-third) of width of third joint; palpi of moderate length *tabaniformis*, Westw.
 Longest hairs in fringe on front margin of third joint of antennae in length equal to from one-half to three-fourths of width of third joint; palpi noticeably long and slender *nigrofusca*, Newst.
 3. Pleurae drab-grey or isabella-coloured, hind coxae buff or greyish-buff. *fusca*, Walk.
 Pleurae dark grey, hind coxae mouse-grey. *fuscipleuris*, sp. nov.

IV.

GLOSSINA BREVIPALPIS GROUP.

1. Dorsum of thorax with four sharply defined, dark brown, more or less oval or elongate spots, arranged in a parallelogram, two in front of and two behind the transverse suture; proboscis bulb with a sharply defined brown or dark brown tip *longipennis*, Corti.
 Dorsum of thorax without such spots; proboscis bulb not brown or dark brown at the tip 2
 2. Wings with upper, thickened portion of anterior transverse vein much darker in colour than adjacent veins, and thus standing out conspicuously against the rest of the wing *brevipalpis*, Newst.
 Wings with upper, thickened portion of anterior transverse vein not much darker in colour than adjacent veins, and thus not standing out conspicuously against the rest of the wings (wings practically unicolorous). *medicorum*, sp. nov.

CHAPTER IV.

THE GLOSSINA PALPALIS GROUP.

SYNOPSIS OF SPECIES.*

1. Dorsum of abdomen ochraceous-buff or buff; third and following segments exhibiting sharply defined, dark brown or clove-brown, interrupted, transverse bands *tachinoides*, Westw.
Dorsum of abdomen not so marked ... 2
2. Third joint of antennae pale (cream-buff to ochraceous-buff), clothed with long fine hair, forming a conspicuous fringe on front and hind margins (*cp.* Fig. 13, p. 36) *pallicera*, Bigot.
Third joint of antennae entirely dark (mouse-grey), except at extreme base on outer side, and without a conspicuous fringe of long fine hair 3
3. Dorsal surface of abdomen dark sepia-brown; median paler area on second segment broad and more or less quadrate or irregular in outline; hypopygium† of ♂ buff or ochraceous-buff *caliginea*, Austen.
Dorsal surface of abdomen blackish-brown; median paler area cuneate (*i.e.* triangular in outline); hypopygium of ♂ grey *palpalis*, Rob.-Desv.

* *Glossina fuscipes* Newst. (see p. 29), which belongs to this Group, is not included in the above Table, since the author has not yet had the opportunity of studying this species.

† See p. 13, note †.

Glossina palpalis, Rob.-Desv.

(Plate I.)

Nemorhina palpalis, Robineau-Desvoidy, Essai sur les Myodaires (Mémoires Présentés par Divers Savans à l'Académie Royale des Sciences de l'Institut de France. Sciences Mathématiques et Physiques. Tome Deuxième), p. 390 (1830).

Glossina longipalpis, Walker (*nec* Wiedemann), Entomologist, VI, p. 328 (1873).

Glossina ventricosa, Bigot, Ann. Soc. Ent. France, 6^e Série, T. 5, pp. 122, 123 (1885).

Glossina longipalpis, Bigot (*nec* Wiedemann), *ibid.* p. 122.

Glossina tabaniformis, Bigot (*nec* Westwood), *ibid.* p. 123.

Glossina longipalpis, Austen (*nec* Wiedemann), Report of the Proceedings of the Expedition for the Study of the Causes of Malaria, etc., p. 18 (1899).

Glossina palpalis, Austen, "A Monograph of the Tsetse-Flies," p. 71, Plate I (1903); Newstead, Dutton and Todd, Annals of Tropical Medicine and Parasitology, Series T. M., Vol. I, No. 1, pp. 57-71, Plate III, figs. 7-9 (February 1, 1907).

Glossina maculata, Newstead, Annals of Tropical Medicine and Parasitology, Series T. M., Vol. I, No. 1, p. 73, Plate III, figs. 5, 6 (February 1, 1907).

♂, ♀.—Length,* ♂ (10 specimens, from different localities) 8 to 9 mm., ♀ (10 specimens, from different localities) 8.6 to 10.2 mm.; width of head, ♂ 2.4 to 2.6 mm., ♀ 2.5 to just under 3 mm.; width of front at vertex, ♂ 0.6 mm., ♀ 1 mm.; length of wing, ♂ 7 to 8.4 mm., ♀ 8.4 to 9.2 mm.

Abdomen clove-brown† or blackish-brown; *thorax* usually paler, with dark brown markings on a greyish ground, as shown in Plate I; *abdomen* generally with at least an indication of a pale or slate-grey longitudinal median stripe, with pale lateral triangular markings, and usually the hind margins of the segments narrowly pale. *Femora* in typical race more or less mouse-grey, greyish-brown, or dark slate-coloured; *tibiae*, extreme tips of femora, and first three joints of front and middle tarsi buff or ochraceous-buff, hind (or middle and hind) tibiae sometimes infuscated in ♂; hind

* The length given is in the case of all species exclusive of the proboscis and palpi, and is measured from the epistoma (front margin of the lower part of the face) to the tip of the abdomen.

† In the names employed for colours throughout this book, the author follows Ridgway's "Nomenclature of Colors for Naturalists" (Boston: Little, Brown, and Company, 1886).

tarsi blackish-brown or clove-brown above; *wings* strongly tinged with sepia-brown, but not quite so dark as in the following species (*G. caliginea*, Austen—Plate II).

Head.—*Face* and *jowls* cream-coloured or cream-buff; posterior surface of head (*occiput*) entirely cinereous; *frontal stripe* varying from ochraceous to dark chestnut; frontal margins (sides of front or parafrontals) greyish, seen from the side with a dark brown elongate area below; ocellar triangle smoke-grey, enclosing the dark-brown ocellar spot, which is joined posteriorly to a sharply defined dark brown band, uniting the vertical bristles and very conspicuous except in the darkest specimens; second joint of *antennae* more or less yellow at the apex in front, third joint narrowly buff at extreme base on outer side, otherwise entirely mouse-grey; *arista* buff, dark brown beneath; *palpi* mouse-grey, blackish on upper side; *proboscis bulb* dark brown.

Thorax.—Dorsum in the most clearly marked specimens bluish-grey or greyish-olivaceous, with brown markings as shown in Plate I. These markings when fully visible are as follows: a narrow stripe on each side of the median line, interrupted before reaching the transverse suture and again before reaching the hind margin; the section of each stripe behind the suture is expanded posteriorly, and the terminal portion of the stripes immediately in front of the hind margin takes the shape of a pair of more or less confluent ill-defined spots, sometimes confluent with the stripes in front; next to the two admedian stripes on each side on the suture itself a more or less sharply defined oval spot; on the outside of this a longitudinal stripe, more or less interrupted and sometimes obsolete in the middle, but in front curving round outwards behind the humeral callus and then running backwards along the lateral margin of the dorsum nearly to the post-alar callus; in the area thus enclosed a broad ill-defined patch in front of and behind the suture, while the lateral stripe itself sends off two prolongations, which run inwards for a certain distance on each side of the suture. Humeral callus with a spot on its upper portion, confluent with the curved stripe behind it; a more or less ill-defined spot on the post-alar callus also. Pleurae olive-grey or smoke-grey in ♂, drab-grey or olive-grey in ♀, a more or less distinct brown patch in the centre of the mesopleura. Scutellum buff or cream-buff, olive-grey at the base, the usual dark brown patch on each side of the median line more or less conspicuous; apical scutellar

bristles in the ♀ variable in length,—sometimes (as in specimens from the Congo Free State and Uganda) short, sometimes (as in specimens from Liberia, Sierra Leone, and the Gambia) nearly as long as in the ♂.

Abdomen.—Dorsum clove-brown or blackish-brown; first segment and a median triangular area on the second (its base resting on the front and its apex on the hind margin of the second segment) buff-coloured or cinereous, the pale triangle continued backwards as a narrow, more or less well-defined median stripe, usually reaching at least as far as the hind margin of the fifth segment; lateral margins of the segments from the second onwards grey, expanded on the apical angles into triangular markings; extreme hind margins of the segments from the second to the sixth usually narrowly pale or grey; seventh segment, as also the hypopygium in the ♂, entirely grey.

Legs.—Last joint of front and middle tarsi dark brown, often more or less buff at base, sometimes distal third alone dark brown, remainder buff; penultimate joint of front and middle tarsi dark brown, more or less buff at base.

Wings as described in diagnosis printed in italics above. *Squamæ* waxen-white, border of the antisquama darker, fringed with short, darker hairs. *Halteres* cream-buff.*

Glossina palpalis var. *wellmani*, Austen.

Glossina palpalis wellmani, Austen, Annals and Magazine of Natural History, Ser. 7, Vol. XV, p. 390 (April, 1905).

Glossina bocagei, França, Jornal de Sciencias Mathematicas, Physicas e Naturaes, 2º Sér., T. VII, No. xxvii, p. 134 (June, 1905).

♂, ♀.—*Distinguishable from typical G. palpalis*, Rob.-Desv., *by a peculiar reduction in the markings of the dorsum of the thorax*.

Frontal stripe pale ochraceous; thoracic markings much reduced, so that *the thorax in a well-preserved specimen appears spotted*, the antero-lateral markings taking the form of spots or blotches; *the spot immediately behind the inner extremity of the*

* For an account of the internal anatomy of *Glossina palpalis*, see Minchin, Proceedings of the Royal Society, Vol. 76B, pp. 531-547 (1905): for the structure of the proboscis, see Stephens and Newstead, Liverpool School of Tropical Medicine, Memoir XVIII, pp. 53-74, Six Plates (1906).

humeral callus on each side small, ovoid, or nearly circular, and especially conspicuous when the insect is viewed from above and slightly from behind; femora pale, the dark area much reduced.

The types of this variety—which are from the Katumbela River, Angola, and were collected in November, 1904, by Dr. F. Creighton Wellman, in whose honour the form was named—are in the British Museum (Natural History). Writing from Benguella on February 5th, 1905, Dr. Wellman said:—"I took about eighty specimens of these Tsetse-flies in four days along the banks of the Katumbela River, two days from the coast, in the height of the rainy season."

Besides occurring in Angola the variety *wellmani* is apparently also found in other localities, as in the Gambia, the Katanga District of the Congo Free State, in the Matondwi Islands in Lake Tanganyika, and elsewhere. It may be added that the National Collection contains a considerable number of specimens from various localities, including the Gambia, Gold Coast, and Northern and Southern Nigeria, which would appear to be intermediate between typical *Glossina palpalis*, Rob.-Desv., and *G. palpalis* var. *wellmani*, Austen.

DISTRIBUTION OF *G. palpalis*, Rob.-Desv.

The area occupied by *Glossina palpalis*, as at present known, includes the whole of West Africa, from the mouth of the Senegal River (about 16° N.) to Angola (where the variety *wellmani* apparently predominates), and extends eastward into the southern Bahr-el-Ghazal. Proceeding southward, the eastern boundary of the species follows the valley of the Nile, and includes the eastern shores of Lakes Victoria (in the East Africa Protectorate and German East Africa) and Tanganyika (in German East Africa), and their affluents; from the southern end of the latter lake the boundary trends south-west, approximately following the frontier between North-Eastern Rhodesia and the Congo Free State, and passing through the Katanga district of the latter country into Angola. *G. palpalis* appears not to occur on Lake Nyasa.

BIONOMICS.

Owing to the limited space available in this volume it has been found altogether impossible to attempt to give a *résumé* of present knowledge of the bionomics of *Glossina palpalis*, concerning

which a mass of literature is already in existence, and is increasing week by week. The latest information on the subject will be found in the monthly "Bulletins" of the Sleeping Sickness Bureau.*

SYNONYMY, AFFINITIES, AND DISTINCTIVE CHARACTERS.

As stated in the author's "Monograph" (p. 78), *Glossina ventricosa*, Bigot, was described from two female examples of *G. palpalis*, Rob.-Desv., in which the abdomen is enormously distended with coagulated blood. Thanks to the generosity of Mr. G. H. Verrall, these specimens are now in the National Collection.

Some few years ago, by the courtesy of Mr. Newstead, the author was enabled to examine the type of *Glossina maculata*, Newst. (a ♀), which proved, in his opinion at any rate, to be a specimen of *G. palpalis*, Rob.-Desv., curiously spotted by some foreign matter. Mr. Newstead is unfortunately unable to accept this conclusion, and it is therefore with especial reluctance that the author of this volume is compelled to state his conviction, and to regard *Glossina maculata*, Newst., as a synonym of *G. palpalis*, Rob.-Desv.†

In external characters, at least, *Glossina palpalis*, Rob.-Desv., is more nearly related to *G. fuscipes*, Newst. (p. 29) and *G. caliginea*, Austen (p. 30, Plate II), than to any other species of the *Glossina palpalis* group yet described. According to Newstead's description of the former species, *G. palpalis* is distinguished from *G. fuscipes* by its much larger size, and by the thorax not being "dusky grey," or the legs "uniformly infuscated or dusky." From *G. caliginea*, Austen, *G. palpalis* is distinguishable, *inter alia*, by the head being distinctly narrower, the arista shorter and stouter, the abdomen blacker, the median paler area on the second abdominal segment cuneate in outline instead of more or less quadrate, and by the wings being paler.

* A most useful summary (by Dr. A. G. Bagshawe, Director, Sleeping Sickness Bureau) of what was known as to the bionomics of *G. palpalis* at the commencement of 1909 is to be found in the Sleeping Sickness Bureau Bulletin, Vol. I, No. 3, pp. 89-106 (January, 1909). This has since been reprinted, and is to be obtained separately from the Sleeping Sickness Bureau, Royal Society, Burlington House, London, W.

† It is perhaps permissible to mention that Mr. C. O. Waterhouse, Vice-President of the Entomological Society of London (late Assistant-Keeper, Insect Section, British Museum (Natural History)), who made an entirely independent examination of the type of *G. maculata*, was emphatically of the opinion that the spotted appearance of the specimen was "not natural."

From *G. pallicera*, Bigot (p. 35, Plate III), the present species, apart from being much darker, may at once be distinguished by the dusky colour of and absence of long hair on the third joint of its antennae. With *G. tachinoides*, Westw. (p. 39, Plate IV), there is no possibility of confusion owing to the characteristic abdominal markings of the former.

Glossina fuscipes, Newst.

Glossina fuscipes, Newstead, Annals of Tropical Medicine and Parasitology, Series T. M., Vol. IV, No. 3, p. 375 (December 20, 1910).

No specimens of this species, of which the type is at present in the possession of the Liverpool School of Tropical Medicine, have yet reached the British Museum (Natural History); the following, however, is a verbatim transcript of the original description.

"This tsetse-fly may be readily distinguished from *Gl. palpalis*, Rob.-Desv., by its much smaller size, by the uniformly infuscated or dusky legs, and the dusky-grey thorax. In size it resembles *G. tachinoides*, West., but it is a relatively stouter built insect; and altogether it is most like a dwarfed specimen of *Gl. palpalis* with infuscated legs and a dusky thorax. The genital armature resembles those of *Gl. palpalis* and *Gl. tachinoides* in its general form; but the shape of the superior claspers and the inferior claspers are markedly distinct from those of either of these insects.

"Length.— $7\frac{1}{2}$ mm.; length of wing, 8 mm.

"**MALE**.—**Head**: frontal stripe yellowish brown, margins dusky white; ocellar triangle buff, enclosing a very dark brown spot. *Antennae* grey; arista dark brown ventrally. *Palpi* smoky-brown, with a paler median line. *Proboscis* with the bulb dark castaneous.

"**Thorax** with a median dark grey rectangular area extending from the front to the scutellum, the sides of which are perfectly straight and parallel, on either side of this grey area are two greyish-black and somewhat triangular blotches, evidently remnants of those found in other species of *Glossina*; scutellum dark grey, with a very faint pale grey median line, margins buff; sides of the lateral thoracic depressions dark brown or almost black; pleurae dark grey.

"**Abdomen** resembling that of *Gl. palpalis*, but the bi-lateral

banding faintly pronounced; lateral margins with pale angular areas.

"*Legs* strongly and almost uniformly infuscated (dark grey); femora with the basal and ventral portions ochreous-buff; hind tarsi all dark brown or almost black.

"*Wings*.—Anterior transverse vein strongly and suddenly incrassate at its junction with the third longitudinal vein.

"*HABITAT*.—The only example which we possess of this interesting tsetse-fly was taken by Dr. Shircore* at Nimule, Nile Province, Uganda. Fortunately it proved to be a male, otherwise it may have passed as a small dusky form of *Glossina palpalis*."

Glossina caliginea, Austen.

(Plate II.)

Glossina caliginea, Austen, Bulletin of Entomological Research, Vol. I, Part 4, pp. 294-297, figs. 1-3 (January, 1911).

♂, ♀.—Length, ♂ (15 specimens) 8 to 8.5 mm., † ♀ (15 specimens) 9 to 10 mm.; width of head 2.8 to 3 mm.; width of front at vertex, ♂ 0.75 mm., ♀ 1 mm.; length of wing, ♂ 8 to 8.75 mm., ♀ 9.4 to 10 mm.

Allied to and resembling *Glossina palpalis*, Rob.-Desv., but browner, and usually somewhat larger; head distinctly broader, front if anything slightly narrower, at least in ♂; dark portion of dorsal surface of abdomen browner (dark sepia-brown, instead of clove-brown or blackish brown), paler area on second segment, instead of being confined to a, usually narrow, median triangle, broad and more or less quadrate or irregular in outline, its lateral margins being generally ill-defined; hypopygium of ♂ buff or ochraceous-buff, instead of grey as in typical *G. palpalis*; pollinose dorsum of seventh abdominal segment in both sexes often cream-buff, and consequently yellower than in *G. palpalis*; extreme hind margins of preceding segments (except posterior angles) never lighter.

Head.—Face, jowls, and occiput coloured as in *G. palpalis*, but sides of face (parafacials) slightly narrower, and jowls not

* "The data here given are taken from Dr. Shircore's letter; the actual locality is not stated by him.—R. N."

† A specimen in the Museum collection with its abdomen distended by coagulated blood measures 9.4 mm. in length.

descending so much posteriorly (*i.e.* lower margin of eye nearer to lower margin of head on each side); *frontal stripe* chestnut;

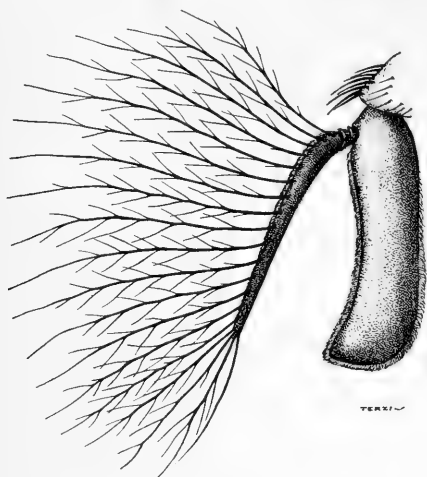


Fig. 11.
Antenna of *Glossina caliginea*, Austen. ($\times 30$)*

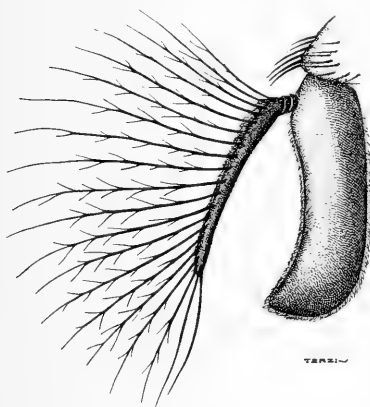


Fig. 12.
Antenna of *Glossina palpalis*, Rob.-Desv. ($\times 30$)

frontal margins (sides of front or parafrontals) varying from light mouse-grey to olive, often darker than in *G. palpalis*,

* The author desires to acknowledge his indebtedness to the Entomological Research Committee (Tropical Africa) for the loan of the blocks for this and the two following figures.

showing, as in the latter species, a dark brown elongate area below when viewed from the side; ocellar triangle drab-grey or mouse-grey, *ocellar spot* and dark brown band uniting vertical bristles as in *G. palpalis*; *antennae* mouse-grey, narrowly cream-buff at apex of second joint and extreme base of third joint on outer side, anterior and posterior edges of third joint in both sexes without a long and conspicuous fringe of fine pale hair* (*cf.* Figs. 11 and 13), and its distal extremity only moderately prominent, *arista* distinctly *longer* and *more slender* (tapering off less abruptly) than in *G. palpalis* (*cp.* Figs. 11 and 12); *palpi* mouse-grey, darker above and towards distal extremity.

Thorax.—Dorsum with dark brown markings of same type as in typical form of *G. palpalis*, but often somewhat more extensive; pleurae and interspaces between markings on dorsum light mouse-grey; *scutellum*, at least in ♀, somewhat more elongate than in *G. palpalis*, apical scutellar bristles in ♀ unusually short, reduced to small spines, hind margin of scutellum and interspace between distal extremities of dark blotches on dorsum cream-buff.

Abdomen.—First segment cream-buff or buff, with a dusky (dark grey) patch on each side; dorsum of second to sixth segments inclusive dark sepia-brown; median paler region on dorsum of second segment cream-buff to ochraceous-buff or pale cinnamon, the central lanceolate area enclosed within the usual admedian grooves exhibited by this segment often paler than the region outside the grooves; one or more of the four segments following the second usually with a paler (buff, ochraceous-buff, or cinnamon-coloured) median area on the dorsal surface; in some specimens the third and fourth, third, fourth, and fifth, or even the third to the sixth segments each show a narrow paler median longitudinal streak, which usually fails to reach the hind margin of each segment; in others the paler area on the third segment, or on the third and fourth segments is as broad as that on the second, while on subsequent segments the paler area is reduced to a streak; lateral margins and posterior angles of second to sixth segments inclusive smoke-grey, scarcely visible from above; pollinose dorsum of seventh segment varying from smoke-grey to cream-buff or buff, often infuscated at base in ♀; *hypopygium* of ♂ resembling that of *G. palpalis*, Rob.-Desv., in

* There is a fringe on the third joint of the antennae, but it is so short and the hairs composing it are so minute as to be scarcely noticeable when the joint is examined in profile under an ordinary platyscopic lens.

shape, but somewhat larger, and, as seen by careful examination from the ventral side, *somewhat squarer* (*i.e.* its posterior margin not quite so much rounded off).

Legs ochraceous-buff; coxae buff, outer surface of front coxae blotched with dark grey; femora, especially front pair, blotched or streaked with dark grey or greyish-brown, front femora often almost entirely dark mouse-grey; last two joints of front and middle tarsi tipped with dark brown; hind tarsi entirely blackish-brown above.

Wings uniformly sepia-brown, fairly dark. *Squamae* light cream-coloured, antisquama hyaline, its fringe brownish.

Halteres cream-buff.

The typical specimens of this species are a ♂ and ♀ from Southern Nigeria, in the British Museum (Natural History), both taken by *Mr. G. Garden*, Veterinary Officer, S. Nigeria, the ♂ on a creek near Akitipupu, 18. v. 1909, the ♀ in a canoe on a creek between Aro Chuku and Itu, 16. iii. 1909.

DISTRIBUTION OF *G. caliginea*, Austen.

Up to the present time, this species has been received only from Southern Nigeria. In addition to the types of the ♂ and ♀, the following specimens are contained in the Museum collection:—1 ♂, Benin (*A. Millson*); 1 ♂, Benin City, 18. iii. 1910, and 1 ♂, Forcados, 30. iv. 1910 (*J. J. Simpson*: presented by the Entomological Research Committee); 1 ♂, Sobo Plains, July, 1904, and 1 ♀, Sapele (*Dr. G. F. Darker*); 1 ♂, 1 ♀, Owa River, Lagos, August, 1904 (*Dr. W. H. W. Strachan, C.M.G.*); 2 ♂♂, 1 ♀, Bende, May, 1908 (*Dr. Gray*: presented by *Dr. W. H. W. Strachan, C.M.G.*); 1 ♂, 2 ♀♀, Oni River, 70 miles east of Lagos, 2, 9, and 29. v. 1910 (*Dr. W. A. Lamborn*: presented by the Entomological Research Committee); 1 ♂, 3 ♀♀, between Aro Chuku and Itu, "caught in canoe on creek," 16. iii. 1909; 2 ♂♂, 1 ♀, between Agbabu and Akitipupu, "caught in canoe on creek," 17 and 19. v. 1909; and 2 ♂♂, 1 ♀, on creek near Akitipupu, 18. v. 1909 (*G. Garden*); 1 ♀, Old Calabar, 14. v. 1900 (*Dr. H. E. Annett*). The following specimens, in the possession of the Entomological Research Committee (Tropical Africa), have also been examined:—3 ♂♂, 4 ♀♀, Oni River, 2, 4, and 9. v. 1910 (*Dr. W. A. Lamborn*); 2 ♂♂, Calabar, 16. vi. 1910 (*J. J. Simpson*).

BIONOMICS.

Glossina caliginea, which, from the data printed above, would appear to be prevalent in parts of Southern Nigeria in the month of May, is evidently prone to attack travellers in canoes. This has been observed both by Mr. Garden and Dr. Lamborn, the former of whom, with reference to the specimens taken by him in a canoe on a creek between Agbabu and Akitipupu, on May 17 and 19, 1909, contributes the interesting note that the flies "attacked during heavy rain"; Mr. Garden also states that at the spot at which the flies were encountered there was "dense cover," consisting of "long grass and water-plants." One of Dr. Lamborn's specimens (a male, taken on the Oni River, on May 9, 1910) bears the following field-note:—"As I was going up river in a canoe at 3.0 P.M., this insect bit me on the arm, and became so distended with my blood that it was unable to fly away." A female in the possession of the Entomological Research Committee, taken by the same collector on the same river and date, bears the label:—"From European's back and distended with his blood, while canoeing up river." A male and female from Dr. Lamborn, caught on May 4, 1910, are labelled as being "off European's clothes, while journeying up river in a canoe," and the remaining specimens of this species received from the same source by the Entomological Research Committee are also stated to have been caught on a European's clothes.

AFFINITIES AND DISTINCTIVE CHARACTERS.

Among the *Glossina palpalis* group of species, with dark hind tarsi, constituted by *Glossina palpalis*, Rob.-Desv., *G. pallicera*, Bigot, *G. fuscipes*, Newst., *G. caliginea*, Austen, and *G. tachinoides*, Westw., the new species can only be confused with the two first mentioned. Care is necessary at the outset in order to distinguish *G. caliginea* from *G. palpalis*, but the very real differences between the two species have been pointed out in the course of the foregoing description. The usually darker hue and larger size of *G. caliginea*, combined with the characters supplied by the third joint of the antennae (dusky coloration, stouter shape, less prominent distal extremity, and especially the absence of a conspicuous fringe of pale hair on the anterior and posterior edges (see Figs. 11 and 13)), will suffice to differentiate the new species from *G. pallicera*.

Glossina pallicera, Bigot.

(Plate III.)

Glossina pallicera, Bigot, *Annales de la Société Entomologique de France*, Année 1891, Vol. LX, p. 378; Austen, "A Monograph of the Tsetse-Flies," p. 79, Plate II (1903).

♂, ♀.—Length, ♂ (8 specimens) 8 to 8.75 mm., ♀ (4 specimens) 8 to 9 mm.; width of head, ♂ ♀ 2.6 to 2.8 mm.; width of front at vertex, ♂ 0.6 mm., ♀ 0.8 mm.; length of wing, ♂ 8 to 8.4 mm., ♀ 8.6 to 8.8 mm.

Ground colour of dorsum of thorax olivaceous or olive-grey, with well-developed, dark sepia-brown, longitudinal markings of usual type; dorsum of abdomen mummy-brown or dark sepia-brown, first segment and a narrow, median, cuneate area on second (not always extending to hind margin) buff; in ♀, portion of second segment immediately adjacent to and on each side of cuneate area, and a corresponding region on third and fourth, or third, fourth and fifth segments, sometimes with exception of hind border in each case, usually cinnamon-coloured, therefore paler than lateral portions of these segments; third joint of antennae pale (cream-buff to ochraceous-buff), clothed with long and fine, pale yellowish hair, forming a conspicuous fringe on front and hind margins (cp. Fig. 13); hind tarsi dark brown above, last two joints clove-brown.

Head buff or cream-buff, face and jowls yellowish pollinose, posterior surface smoke-grey, sides of front (parafrontals) and ocellar triangle mouse-grey; *frontal stripe* cinnamon-rufous, upper portion more or less mummy-brown; *ocellar spot* dark brown, connected with usual dark brown transverse band joining bases of vertical bristles; second joint of *antennae* buff (brownish or dark brown above), third joint usually long and slender, often brownish or mouse-grey at and towards distal extremity, which is prominent, *arista* buff, dark brown beneath, terminal joint long and slender, branched hairs eighteen to twenty-three or twenty-four in number; *palpi* buff or cream-buff, greyish above and dark brown at tips; *proboscis bulb* raw-umber-coloured, dark brown on upper edges.

Thorax.—Humeral calli, pleurae, and pectus smoke-grey, humeral calli with a dark brown spot next upper margin, sometimes wanting or indistinct; scutellum raw-umber-coloured, with a more or less sharply defined dark brown blotch, roughly

triangular in outline, on upper surface on each side of middle line; apical scutellar bristles in ♀ sometimes very short, but varying in length in different individuals from one-sixth to one-half of that of those of ♂.

Abdomen.—Posterior angles of third to sixth segments inclusive, seventh segment entirely, and hypopygium of ♂ isabella-coloured or drab, pollinose; interspace between hectors of ♂ very narrow or non-existent.

Legs yellowish clay-coloured; front femora infuscated on inside (an especially dark blotch on distal third, not extending

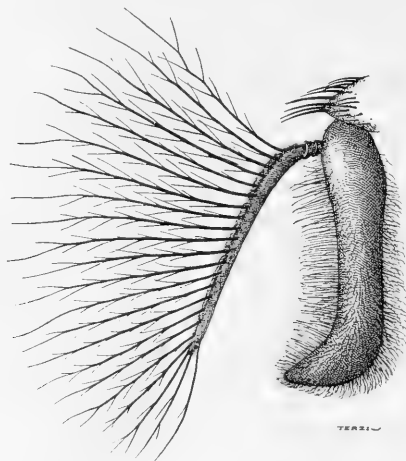


Fig. 13.
Antenna of *Glossina pallicera*, Bigot. ($\times 30$.)

to tip), middle and hind femora more or less tinged with mouse-grey on outer side, and on under side with an elongate clove-brown blotch near distal extremity, usually connected with a smaller mark of similar colour on outer side just before tip; distal margin of penultimate joint of front and middle tarsi brown or dark brown, rather less than distal half of last joint of front and middle tarsi dark brown, extreme tips of remaining joints of front and middle tarsi often tinged with mummy-brown.

Wings with a strong brownish tinge. *Squamæ* cream-coloured. *Halteres* buff.

DISTRIBUTION OF *G. pallicera*, Bigot.

Glossina pallicera is a West African species, which is apparently one of the rarest of the Tsetse-flies at present known, and of which the area of distribution extends, at any rate, from the Sierra Leone Protectorate to French Congo. The following are the details with reference to the specimens in the National Collection:—Sierra Leone Protectorate: 1 ♂, Firo, 17. iv. 1909 (*Major A. Pearce, R.A.M.C.*). Liberia: 1 ♀, Tappoima, 11. v., 1 ♀, Suji, 21. v., 1 ♂, Bonnatown, 22. v. 1909 (*Major A. Pearce, R.A.M.C.*). French Ivory Coast: 1 ♂ (*the type of the species*), 1 ♀, Assinie (*Ch. Alluaud*; presented by Mr. G. H. Verrall, from the collection of the late M. Bigot). Ashanti: 1 ♀, Kumasi, 19. vii. 1907, "caught on horse on polo ground" (forwarded by *Dr. T. E. Rice, S.M.O.*; presented by *Dr. W. M. Graham, W.A.M.S.*); 3 ♂♂, Kumasi, 26, 27. x. 1907, "caught on N'Kawi Road, 11.0 A.M.," "caught on palm stump in bush path on the N'Kawi Road," and "caught on N'Kawi Road, 3.0 P.M." (*Dr. W. M. Graham, W.A.M.S.*); 1 ♂, Prahsu, 16. xii. 1907, "caught behind kitchen" (*Dr. W. M. Graham, W.A.M.S.*). Southern Nigeria: 1 ♂, Ojogbo, Benin City, 16. iii. 1910 (*J. J. Simpson*: received from the Entomological Research Committee).

As regards French Congo, a specimen of *G. pallicera* is stated by Professor Laveran to have been taken on the Benue River (Mayo-Kabbi region), in January or February, 1907, by Dr. Ducasse.* In Ashanti, according to Dr. Graham, the species appears to be "extremely local."

BIONOMICS.

For the few details that can be given under this heading we are indebted to the observations made in Ashanti, in 1907, by Dr. W. M. Graham, who informed the author that he always found the fly in the "bush," where it "does not settle on the ground, but sits on the upper side of leaves." Writing of this Tsetse as met with by him on the N'Kawi Road, Kumasi, Dr. Graham says:—" *G. pallicera* was found in a narrow bush path, bordered by short bushes, but free from tall trees. . . . This fly appeared strictly localised. I found it only on this

* Cf. A. Laveran, Bulletin de la Société de Pathologie Exotique, T. i, p. 254 (1908).

narrow path. It did not associate with *G. palpalis* upon this path, nor was it to be found associated with *G. palpalis* upon the main road into which the path opens. The insects were found sunning themselves upon the leaves of the tall plants bordering the path, or playing in sunshine about the stumps of a fallen palm (*Elais guineensis*). I caught a number of males, but though I spent some hours there, and returned to the path on a second occasion, when I again caught males, I failed to catch a female on either occasion. Though I sat among the insects for some hours no attack was made upon me by them."* With reference to the last remark by Dr. Graham, it may be noted that the abdomen of the female fly caught on a horse on the polo ground, Kumasi, as recorded above, is distended by coagulated blood. In Ashanti it appeared to Dr. Graham that in the case of *G. palpalis* the females were more aggressive than the males, and possibly this is also true of *G. pallicera*.

AFFINITIES AND DISTINCTIVE CHARACTERS.

With *Glossina palpalis*, Rob.-Desv. (p. 24, Plate I), *G. fuscipes*, Newst. (p. 29), *G. caliginea*, Austen (p. 30, Plate II), and *G. tachinoides*, Westw. (p. 39, Plate IV), *G. pallicera* forms the *Glossina palpalis* group of Tsetse-flies, the members of which are characterised by all the joints of the hind tarsi being wholly or for the most part blackish-brown, clove-brown, or dark brown above. With *G. tachinoides*, owing to its abdominal markings and much smaller size, there is no risk of confusion (compare Plates III and IV); from all other species of the *Glossina palpalis* group at present known, *G. pallicera*, although exhibiting an exceedingly close resemblance in general appearance to an unusually light-coloured *G. caliginea*, can at once be distinguished by the coloration, shape, and hairiness of the third joint of the antenna, as described above.

* From "Report by Dr. W. M. Graham upon Entomological Observations made in Southern and Central Ashanti, 1907," p. 3 (printed for private circulation by the Colonial Office, 1909).

Glossina tachinoides, Westw.

(Plate IV.)

Glossina tachinoides, Westwood, Proc. Zool. Soc. Lond., Pt. xviii, p. 267, Plate XIX, fig. 2 (1850); Ann. Mag. Nat. Hist., Ser. 2, Vol. X, p. 147 (1852); Austen, Ann. Mag. Nat. Hist., Ser. 7, Vol. XIV, pp. 152-154 (1904); British Medical Journal, September 17, 1904: Captain R. Markham Carter, I.M.S., British Medical Journal, November 17, 1906, p. 1393.

Glossina palpalis var. **tachinoides**, Austen, "A Monograph of the Tsetse-Flies," p. 74 (1903).

Glossina Decorsei, Brumpt, Comptes rendus des séances de la Société de Biologie (Séance du 16 Avril, 1904), T. lvi, p. 628 (1904).

♂, ♀.—Length, ♂ (9 specimens) 6 to 6.75 mm.,* ♀ (9 specimens) 6.8 to 8.4 mm.; width of head, ♂ 2 to 2.2 mm., ♀ 2.2 to 2.25 mm.; width of front at vertex, ♂ 0.5 mm., ♀ 0.75 to 0.8 mm.; length of wing, ♂ 6 to 6.5 mm., ♀ 7 to 7.8 mm.

ONE OF THE SMALLEST OF THE KNOWN TSETSE-FLIES.—*Dorsum of thorax olive-grey or smoke-grey, with dark brown longitudinal markings of usual type, though often indistinct; ground colour of abdomen ochraceous-buff or buff, dorsum with sharply defined clove-brown or dark brown markings as shown in Plate IV, second segment with a very conspicuous, square or oblong, pale (ochraceous-buff or buff) area in centre; hind tarsi dark brown, i.e. all the joints more or less dark, extreme tips of first three joints and extreme bases of second and third joints buff, a larger or smaller area at base of first joint also paler than remainder of joint, especially in ♀.*

Head cream-buff pollinose, posterior surface smoke-grey, sides of front (parafrontals) and ocellar triangle light grey, a darker blotch sometimes visible on each parafrontal about midway between ocellar spot and base of antennae; *frontal stripe* ochraceous or tawny-ochraceous, ramus on each side of ocellar triangle brownish; *ocellar spot* dark brown, connected with usual dark brown transverse band joining bases of vertical bristles; *antennae* partly brown or brownish, partly buff, second joint brown or dark brown on inner surface and usually buff on outer side, sometimes brownish on outer side also and buff only at tip,

* A ♂ from the Benue River, Northern Nigeria (*Dr. K. Mackay*), in the Museum collection, the abdomen of which is distended by coagulated blood, measures 7.25 mm. in length.

third joint greyish-brown or mouse-grey, more or less tinged with buff at base, arista buff, second joint and proximal half of terminal joint dark brown below, branched hairs fourteen to sixteen in number; *palpi* buff-yellow, greyish-brown at tips; *proboscis* *bulb* mummy-brown or raw-umber-coloured.

Thorax.—Humeral calli and pleurae drab-grey, former with a dark brown spot or blotch above (sometimes wanting or indistinct); pectus smoke-grey; scutellum cream-buff, with a dark brown blotch, roughly triangular in outline, on upper surface on each side of middle line; apical scutellar bristles in ♀ about one-third of length of those of ♂.

Abdomen.—Median quadrate pale area on dorsum of second segment very conspicuous, and (regarded in conjunction with the dark hind tarsi) distinctive, owing to its shape; dark brown or clove-brown interrupted bands on subsequent segments, as shown in Plate IV, not reaching either lateral or posterior margins; seventh segment cream-buff or smoke-grey pollinose, in ♀ sometimes with a trace of dark markings like those on preceding segment; hypopygium of ♂ oval, pale isabella-coloured.

Legs buff, hind tarsi as described in diagnosis printed in italics above; front or front and middle femora more or less grey on outer side, hind femora also sometimes with a greyish infuscation on outer side towards distal extremity, middle femora with a conspicuous dark brown elongate blotch on under side near tip, hind femora with a trace of a similar mark; tips of last two joints of front and middle tarsi mummy-brown, tips of remaining joints of middle and sometimes also of front tarsi faintly brownish.

Wings tinged with drab. *Squamae* waxen-white, fringe short, yellowish. *Halteres* cream-coloured.

The foregoing re-description is mainly based on a ♂ and ♀ in the British Museum (Natural History), taken at a spot six miles south of Mulgue, Bornu Province, Northern Nigeria, on July 22nd, 1910, by Dr. B. Moiser, W.A.M.S.

DISTRIBUTION OF *G. tachinoides*, Westw.

G. tachinoides has a very wide range in West Africa, where, as for instance in Northern Nigeria, it is often locally abundant. Besides being found from Senegal to French Congo, the species also occurs in the French Sudan (on the shores of Lake Chad and the banks of the Bani and Shari Rivers); and, although not yet

recorded from the Congo Free State or the Uganda or East Africa Protectorates, its range evidently extends right across Africa, since *G. tachinoides* is not only reported to exist in German East Africa,* but has also been met with in Southern Arabia,† thus being so far as is known the only existing species of *Glossina* found outside the African continent and certain of the islands off the coast.

As regards the French possessions in West Africa, *G. tachinoides* has been identified by Professor Laveran from Casamance, Marigot de Bayla, Bignona, and Carabane in Senegal; the Lower Rio Nunez, Boké, and the Tinkisso River in French Guinea; the banks of the Bani and Shari Rivers in the French Sudan; and the Mayo-Kabbi region in French Congo.‡

Of this species the British Museum (Natural History) at present possesses 44 ♂♂ and 69 ♀♀, the details with reference to which are as follows:—

Gambia: 1 ♂, 2 ♀♀, Gambia River, 1907 (*G. C. Dudgeon*).
Gold Coast: 1 ♂, Lorha R., Northern Territories, February, 1908, and 1 ♂, 2 ♀♀, Volta R., north of Krachi, March, 1908 (*G. C. Dudgeon*); 1 ♀, between Salaga and Makongo, Northern Territories, "caught at Tonga (temporary resting-place for native caravans), by a water-hole, empty though still damp, dug in the dry bed of a stream," 14. ii. 1910 (*Dr. T. J. A. Beringer*).
Northern Nigeria: 2 ♀♀, Yola, Benue R., 12. iii. 1904, 3 ♂♂, Pakim, Kilengi R., 24. iv. 1905, 2 ♀♀, Mutum Bui, Benue R., and 2 ♀♀, near Mairanewra, Benue R., 24. v. 1904, 3 ♂♂, 1 ♀, Kamberi, Benue R., 25. v. 1904, 1 ♀, near Amara, Benue R., 26. v. 1904, 2 ♂♂, 8 ♀♀, Jibu, Benue R., 28, 29. v. 1904, 1 ♂, 3 ♀♀, near Ibi, Benue R., 29. v. 1904, 1 ♂, 1 ♀, two days below Ibi, Benue R., "biting donor in canoe," 2. vi.

* *Apud* Stuhlmann (Arbeiten a. d. Kais. Gesundheitsamte, Bd. xxvi, Heft 3, p. 301 (1907)), *G. tachinoides* occurs in German East Africa, in the vicinity of Amani, at the foot of the Usambara Mountains.

† *Cf.* Captain R. Markham Carter, I.M.S., "Tsetse-Fly in Arabia": British Medical Journal, November 17, 1906, p. 1393. This does not invalidate the generalisation that existing Tsetse-flies are confined to the Ethiopian Region, since the southern portion of Arabia belongs zoo-geographically to the region in question. In addition to *G. tachinoides*, many other African insects occur on the eastern shore of the Strait of Bab-el-Mandeb.

‡ *Cf.* A. Laveran, "Contribution à l'étude de la répartition des mouches tsétsé dans l'Ouest africain français et dans l'Etat indépendant du Congo" (Comptes rendus des séances de l'Académie des Sciences, t. cxli, pp. 929-932 (1905)); and "Contribution à l'étude des mouches piquantes de l'Afrique intertropicale" (Bulletin de la Société de Pathologie Exotique, T. i, pp. 252-255 (1908)).

1904, 1 ♂, 1 ♀, three days below Ibi, Benue R., 3. vi. 1904, 2 ♀ ♀, four or five miles below Albins, Benue R., 4. vi. 1904, 1 ♀, ten miles below Amagede, Benue R., 7. vi. 1904, 1 ♀, three miles above Loko, Benue R., 5. vi. 1904, 1 ♂, 2 ♀ ♀, near Dakmon, Kaduna R., 21, 22. vi. 1906, 1 ♂, 1 ♀, near Mureji, Kaduna R., 22, 24. vi. 1906, 1 ♂, 1 ♀, near Egga, Niger R., 24. vi. 1906, 1 ♂, 1 ♀, near Muye, Niger R., 3 ♀ ♀ near Baro, Niger R., 25. vi. 1906 (*W. F. Gowers*); 2 ♂ ♂, 3 ♀ ♀, Benue R., 1. x. 1905 (*Dr. K. Mackay*); 1 ♂, 1 ♀, Pateji, Niger R., Ilorin Province, November, 1904, "caught in the bush" (received from Sir F. D. Lugard, K.C.M.G.); 1 ♂, Adiale, Bassa Province, November, 1906 (*Dr. G. J. Pirie, W.A.M.S.*); 1 ♂, Niger R., at junction of Menai R., 19. xi. 1906, "taken on horse's fetlock, in shade of leafy trees close to water's edge, where there is a stone cliff," 2 ♀ ♀, * Niger R., right bank, between Yantalah and Borgu, 29. xi. 1906, "on canoe-men" (*Major C. B. Simonds, R.G.A.*); 1 ♀, Kaoge, 1. vi. 1907, 1 ♂, Garra Gabbus, July, 1907, 2 ♀ ♀, Aida and Dongwan, Ka R., 18. vii. 1907, 2 ♀ ♀, Loko, Benue R., and 1 ♀, Katsena Allah, August, 1907 (*J. Brand*); 3 ♀ ♀, South Bornu, September, 1907 (*Dr. H. A. Foy, W.A.M.S.*); 2 ♂ ♂, Benue R., 2. vii. 1907 (*Dr. J. McF. Pollard, W.A.M.S.*); 4 ♀ ♀, Dugurie, October, 1907, "swarming on the banks of a stream of black, evil-smelling water" (*Captain H. D. Foulkes*); 1 ♂, Bebu, Bade R., Bauchi Province, 2,000 ft., 1909, "*G. tachinoides* in far greater numbers than *G. palpalis* on Bade R. (a small stream) and its little tributaries" (*Dr. J. McF. Pollard, W.A.M.S.*); 1 ♀, Niger R., south of Baro, 21. vii. 1909 (*Dr. R. F. Williams, W.A.M.S.*); 2 ♂ ♂, 2 ♀ ♀, Baro, Niger R., 1909 (*Dr. E. A. Chartres, W.A.M.S.*); 1 ♂, Niger R., near Jebba, October, 1909 (*Dr. C. W. McLeay*); 4 ♂ ♂, 1 ♀, Ibi, Benue R., 5, 10, 16, 24. x. 1909 (*Dr. H. A. Foy, W.A.M.S.*); 1 ♂, 2 ♀ ♀, one day below Geidam, Wobe R., November, 1909, "very active and most difficult to catch" (*Dr. G. J. Pirie, W.A.M.S.*); 4 ♂ ♂, 3 ♀ ♀, Bornu Province, six miles south of Mulgue, 22. vii. 1910 (*Dr. B. Moiser, W.A.M.S.*). Southern Nigeria: 2 ♂ ♂, Ikom, Cross R., Eastern Province, 17. vi. 1910 (*Dr. W. S. Clark*). French Sudan: 1 ♂, 1 ♀, Goulfei, Shari R., 1904 (*Dr. Decorse*—presented by Dr. É. Brumpt); 1 ♂, 1 ♀, Shari River Delta, Lake Chad, 19. xi. 1907

* In a note attached to one of these, Major Simonds states that he "saw probably the same species near Bajibo (Nupe Province), on the left bank of the Niger, but could not capture a specimen."

(Major C. B. Simonds, R.G.A.). German East Africa: 1 dried larva, 3 pupa-cases, Amani, 1907 (Dr. F. Vosseler). South Arabia: 1 ♀, North Subaihi, between Nakil Madraga and the Al Hay section of Subaihi, 1903 (Captain R. M. Carter, I.M.S.).

The species under consideration is evidently very widely distributed along the rivers and streams of Northern Nigeria. In Katagum Province, in 1907, Dr. J. M. Dalziel, W.A.M.S., found *G. tachinoides* together with *G. morsitans*, Westw., to be common in the region about Hadejia, and for some twenty miles to the east. Six miles or so south of Mulgue, Bornu Province, on July 22, 1910, Dr. Bernard Moiser, W.A.M.S., found *G. tachinoides** along the course of a river-bed, the river at that time "being represented by a series of detached pools, surrounded by rank grass; prickly thorns and a few tall, shady trees grew on the banks, which were in some places twenty feet high . . . The river runs north through Mulgue to Lake Allo, about thirty miles away, where large herds of cattle are annually grazed."†

In Nigeria it was found a few years ago by Mr. G. C. Dudgeon that the areas of occurrence of *G. tachinoides* appeared to alternate with those of *G. palpalis*. "In the lower Niger," writes the author referred to, "as far up as Iddah, an almost black form of *G. palpalis* is found, from Lokoja to Baro *G. tachinoides* occurs commonly, from Egga (a few miles beyond Baro) to Muraji (junction of Kaduna River) typical *G. palpalis*, and from Muraji up the Kaduna to Dakmon *G. tachinoides* again was the only species seen."‡ In Togoland, however, Dr. Zupitza met with both species together on the Oti River (a large tributary of the Volta), although "on the German bank of the Volta north of 8° *Glossina tachinoides* was found and no *palpalis*."§ In the Western Province of Ashanti, in 1910, Dr. A. Kinghorn always found *G. tachinoides* together with *G. palpalis* on the Tain and Black Volta Rivers, the former species being the commoner; Dr. Kinghorn believes that both occur on the Volta, "from its mouth to the French border."||

* Mixed with *G. morsitans*; out of thirty specimens sent to the author for identification, twenty-nine were *G. tachinoides*, and one was a *G. morsitans*, Westw.

† Dr. B. Moiser, in litt., 15. viii. 1910.

‡ G. C. Dudgeon, "The Journal of Tropical Medicine," Vol. IX, No. 21, p. 328 (November 1, 1906).

§ Cf. Sleeping Sickness Bureau Bulletin, Vol. II, No. 16, p. 149 (April 11, 1910).

|| *Ibid.* Vol. II, No. 21, p. 380 (November 5, 1910).

BIONOMICS.

Writing in the Sleeping Sickness Bureau Bulletin No. 6 (May 7th, 1909), p. 210, Dr. A. G. Bagshawe remarks that *Glossina tachinoides* "at least in Nigeria and on the Lake Chad waterways, is confined to river banks as is *palpalis* and occurs in large numbers, biting man. It is therefore allied in its habits to *palpalis*." That the species with which we are dealing is found only in close proximity to water certainly seems to be generally true with regard to the region referred to, though in Southern Arabia Captain R. M. Carter did not always meet with it near the edge of water, and no information is at present available as to the haunts of *G. tachinoides* in German East Africa. Since *G. tachinoides* belongs to the *G. palpalis* group of the genus *Glossina*, it is natural that its habits should be similar to those of the recognised carrier of sleeping sickness. Recently in South Bornu, Northern Nigeria, Dr. Alexander found *G. tachinoides* in a large marsh consisting of long elephant grass mixed with occasional clumps of palm trees and thick undergrowth, though he failed to discover the fly on the banks of a river some three quarters of a mile away.* Dr. Dalziel, writing from Yola Province, Northern Nigeria, states that "*Glossina tachinoides* seems to be found only close to the river bank, in sight of water almost, though it may follow along the path. The longest distance to which it was found to follow away from water was 1,200 yards (one fly). *Glossina morsitans* on the other hand, has not been seen directly at the river bank, being always out of sight of water, in bush with thick grass and shrubs, trees, and climbers. Both species are found together on paths through the bush near water."† In the Western and Northern Provinces of Ashanti, on the Tain and Black Volta Rivers, Dr. A. Kinghorn finds that in habitat and habits *G. tachinoides* closely resembles *G. palpalis*, in company with which it always occurs. According to Kinghorn, the present species "will feed on man with avidity," and is "quite active in dull weather and in the very early hours of the morning, both times when *Glossina palpalis* is usually quiescent."‡ According to Dr. Alexander, on a river near Amar, in South Bornu, "*Glossina tachinoides* bites

* Cf. Sleeping Sickness Bureau Bulletin, Vol. III, No. 24, p. 93 (February 15, 1911).

† Sleeping Sickness Bureau Bulletin, *loc. cit.*

‡ Cf. Sleeping Sickness Bureau Bulletin, Vol. III, No. 25, p. 136 (March 14, 1911).

after dark. At 7.0 p.m. he had to take refuge in his mosquito net, and his boys remarked that the flies were more troublesome than mosquitoes." * Brumpt,† writing of this species under its synonym *G. decorsei*, says that in the Shari River basin and on the shores of Lake Chad, where the natives associate the bite of the fly with disease among their cattle, it appears to be confined to the water's edge, and that in the month of March the males are more numerous than the females. According to Brumpt, the bite of *G. tachinoides* "is disagreeable, as is that of all the species of *Glossina*, but not very painful; it causes some time after the bite a rather acute itching."

In Central Dahomey, according to Roubaud,‡ *G. tachinoides* is a migratory species, which comes from the north, and "is present in abundance on the banks of the large watercourses only from May to August, when the rains are at their height and considerable changes in the river-systems take place. Its habitat is the same as that of *G. palpalis*, though it displays a preference for more open wooded tracts, and is not found in the groves of wild palms along the small streams." Roubaud states that in Dahomey during the wet season, when the air is saturated with moisture, *G. tachinoides*, *palpalis*, and *longipalpis* are all found beyond the limits of their usual haunts, and isolated specimens may be met with in the savannah zone, far from any watercourse.

On the Wobe River, North Bornu, Northern Nigeria, Dr. G. J. Pirie, in November, 1909, found *G. tachinoides* "restricted to patches sometimes on one bank, sometimes on the other. 'The fly patches always occurred where the main river stream came right up to its bank, and the bank at the patches was covered with river bush with thick undergrowth. At one or two places the 'fly' came off to the barge in numbers, but were very difficult to catch. Where the river bush was thin, no fly was seen.' No evidence of trypanosomiasis in man or animals could be obtained."§ At Bebuia, Bauchi Province, Northern Nigeria, where, as already mentioned, Dr. J. McFarlane Pollard found *G. tachinoides* "in far greater numbers than *G. palpalis* on the Bade River (a small stream) and its little tributaries,"

* Sleeping Sickness Bureau Bulletin, Vol. III, No. 24, pp. 92, 93 (February 15, 1911).

† Brumpt, *loc. cit.* p. 629.

‡ Comptes Rendus de l'Académie des Sciences, T. 152, No. 7, p. 406 (Février 13, 1911).

§ Sleeping Sickness Bureau Bulletin, Vol. II, No. 16, pp. 146-147 (April 11, 1910).

the cover consisted of "long thick grass, and trees overhanging the stream." In a note attached to his specimens, Dr. Pollard adds that there was "plenty of shade, but the trees were by no means continuous."

In Southern Arabia, *G. tachinoides* was found by Captain R. M. Carter sparsely and locally in thick belts of euphorbia, babal thorn, and tamarisk, and also in cactus belts. It was never seen "in the date groves or along patches of cultivation," and was not always met with near the edge of water. Captain Carter writes:—"The Arabian *Glossina tachinoides* does not depend for its existence on big game, for, excepting gazelle, nothing else frequents the belts of bush which it haunts. Only once was the fly recognised by Arabs, and then by a band of wild Bedouins from North-Western Subaihi. . . . They stated this fly used to be more frequent in Subaihi, that it bit goats, donkeys, horses, dogs, and men, but did not attack camels or sheep. They further stated that it sucked blood only after the spring rains, that some years it disappeared from a district entirely, that rarely it became abundant, and then they moved their settlement and cattle by night marches to a fly-free district." *

REPRODUCTION AND PRELIMINARY STAGES.

Roubaud, who in Dahomey has observed the behaviour of *G. tachinoides* in captivity, states that, as in the case of *G. palpalis* under similar conditions, copulation takes place directly after the flies are hatched. At 25° C. (77° F.) larvae are deposited on the average at intervals of eight days; the duration of the pupal stage at a mean temperature of 24° to 25° C. (75·2° to 77° F.) was found to be from twenty-eight to thirty-five days.†

A dried and apparently not quite mature *larva* of this species, from Amani, German East Africa (*Dr. F. Vosseler*), measures 6 mm. in length, but, since the specimen is unfortunately somewhat crushed, its maximum breadth cannot be stated. A *pupa* (Figs. 5 E and 6 E, pp. 5 and 7) from Amani, also presented by Dr. Vosseler, is 5·5 mm. long, by 3 mm. in greatest width. These specimens show that the most striking characteristic of the larva and pupa of *G. tachinoides* is the relatively large size of the tumid lips, which are actually larger

* Captain R. M. Carter, I.M.S., *loc. cit.*

† Cf. Roubaud, *loc. cit.*, p. 407.

than in the case of *G. pallidipes* (compare Figs. 6 E and 6 D, p. 7), though the perfect insect of the latter is of course a much bigger fly than *G. tachinoides*. In the present species the tumid lips are just under 1 mm. in length, and the notch between them is similar in shape to that between the lips of the pupa of *G. morsitans*, although not so narrow (compare Figs. 6 E and 6 C, p. 7). The notch is much wider than, and has not the characteristic shape of that exhibited by the pupa of *G. palpalis* (compare Figs. 6 E and 6 F, p. 7).

SYNONYMY, AFFINITIES, AND DISTINCTIVE CHARACTERS.

The identity of *Glossina decorsei*, Brumpt, with *G. tachinoides*, Westw., was proved by the examination of specimens belonging to the original series of *G. decorsei*, kindly submitted to the author by Dr. Brumpt.*

G. tachinoides, which, besides being one of the smallest, is also one of the most easily recognised members of its genus, is readily distinguishable from the other species of the *G. palpalis* group, to which it belongs, owing to the colouration and markings of its abdomen, in which respects it presents a closer resemblance to *G. pallidipes*, Austen, or *G. longipalpis*, Wied., than to any species of its own group. The characteristic shape of the median pale area on the second abdominal segment, to which attention has already been drawn, will however at once enable *G. tachinoides* to be distinguished from any species of the *G. morsitans* group, even though the hind tarsi be missing.

* Cf. E. E. Austen, "Supplementary Notes on the Tsetse-Flies (Genus *Glossina*, Wiedemann)": a Paper read in the Section of Tropical Diseases at the Annual Meeting of the British Medical Association, Oxford, July, 1904: British Medical Journal, September 17, 1904.

CHAPTER V.

THE GLOSSINA MORSITANS GROUP.

SYNOPSIS OF SPECIES.

- | | |
|---|-----------------------------|
| 1. Last two joints of front and middle tarsi with sharply defined, clove-brown or black tips... | 2 |
| Last two joints of front and middle tarsi without sharply defined, clove-brown or black tips (front and middle tarsi either entirely pale or, at most, last two joints of front tarsi faintly brownish at the tips, and last joint and distal half of penultimate joint of middle tarsi light brown—never so dark as to form a sharp contrast with the remaining joints)..... | |
| 2. Third joint of antennae with a distinct fringe of fine hair on front margin; dark brown or clove-brown bands on abdominal segments extending close to hind margins (<i>i.e.</i> pale ground colour, apart from the median interspace, confined to a very narrow hind border)..... | <i>pallidipes</i> , Austen. |
| Third joint of antennae without a distinct fringe of fine hair on front margin; dark brown or clove-brown bands on abdominal segments not extending close to hind margins | <i>longipalpis</i> , Wied. |
| | <i>morsitans</i> , Westw. |

Glossina morsitans, Westw.*

(Plate V.)

Glossina morsitans, Westwood, Proc. Zool. Soc. Lond., Part xviii, p. 261, Plate IX, figs. 1, 1a—1f (1850); Kirk, "On the 'Tsetse' Fly of Tropical Africa" (*Glossina morsitans*, Westwood), Journ. Linn. Soc., Zoology, Vol. VIII, pp. 149–156 (1865); Austen, "A Monograph of the Tsetse-Flies," p. 81, Plate III (1903), and British Medical Journal, September 17th, 1904; Sander, "Die Tsetsen," pp. 60–63 (Leipzig: J. A. Barth, 1905); Newstead, Bulletin of Entomological Research, Vol. II, Part 1, p. 32, fig. 16 (male genitalia) (April, 1911).

♂, ♀.—Length, ♂ (15 specimens, from various localities) 7·2 to 9 mm., ♀ (11 specimens, from various localities) 8·6 to

* The designation *Glossina morsitans*, as used in this book, includes *G. submorsitans*, Newst. As explained on pp. 51, 52, the author, provisionally at any rate, is inclined to regard *G. submorsitans*, Newst., as a form or race of *G. morsitans*, Westw., rather than as a distinct species.

9.6 mm.; width of head, ♂ 2.4 to 2.75 mm., ♀ 2.5 to just under 3 mm.; width of front at vertex, ♂ 0.6 mm., ♀ 0.8 to 1 mm.; length of wing, ♂ 7.6 to 8.2 mm., ♀ 8.2 to 9.5 mm.

Dorsum of thorax light grey, olivaceous-grey, or smoke-grey in ♂, drab-grey in ♀, the thoracic markings in both sexes incompletely developed, and reduced to brownish or mouse-grey longitudinal streaks; *dorsum of abdomen* buff to ochraceous-buff (in pinned specimens sometimes mouse-grey or olivaceous owing to post mortem changes), with a larger or smaller clove-brown blotch (sometimes indistinct or almost wanting) near each basal angle of the second segment, and the third to the sixth segments inclusive each with a very conspicuous clove-brown transverse band, interrupted in the median line, not reaching the lateral margins, and not extending beyond the basal three-fourths of the segment, if so far; *legs* buff, last two joints of hind tarsi clove-brown or black, last two joints of front tarsi and penultimate joint of middle tarsi conspicuously tipped with clove-brown or dark brown, last joint of middle tarsi entirely dark brown above in typical race, otherwise distal half or third of last joint of middle tarsi alone dark brown or clove-brown, remainder of joint merely brownish or even entirely pale.

Head cream-buff, face and jowls cream-coloured pollinose, posterior surface olive-grey or smoke-grey, ocellar triangle smoke-grey, sides of front (parafrontals) in ♀ each with a dark brown blotch on upper part of lower half, wanting or at any rate smaller and less conspicuous in ♂; *frontal stripe* buff, its upper or posterior extremity often more or less mummy-brown; *ocellar spot* dark grey, spots at base of vertical bristles dark brown, sometimes connected by a transverse band of similar colour; first and second joints of *antennae* dark brown, distal extremity of second joint buff, third joint mouse-grey or drab-grey, posterior basal angle buff, front margin not fringed, arista buff, penultimate joint at base and lower margin of proximal extremity of terminal joint dark brown, branched hairs about twenty-one in number; *palpi* buff, yellowish-grey above, tips mouse-grey or dark grey; *proboscis bulb* clove-brown or dark brown.

Thorax.—The markings on the dorsum are more or less incomplete vestiges of those exhibited by *Glossina palpalis*, Rob.-Desv. (compare Plates V and I); *pleurae* smoke-grey in ♂, drab-grey in ♀, *pectus* smoke-grey; *scutellum* cream-buff, upper

surface with a dark brown or brownish patch, triangular in outline, on each side of median line; apical scutellar bristles in ♀ extremely short, reduced to mere stumps.

Abdomen.—On dorsal surface, basal angles of second segment greyish, seventh segment, posterior margin of sixth and sometimes also that of fifth segment, and lateral margins and posterior angles of second to sixth segments inclusive light grey pollinose; the clove-brown, interrupted, transverse bands taper more or less abruptly towards the basal angles of the segments on which they are present, and at the median interruption, though sometimes straight-cut, are, in the more typical forms, generally more or less rounded off or even partially obliterated; the obliteration of

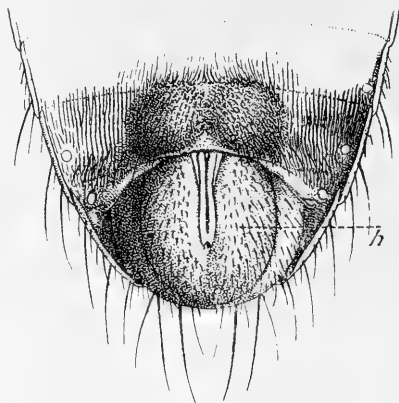


Fig. 14.

Distal portion of abdomen of *Glossina morsitans*, Westw., ♂ (ventral aspect), showing (*h*) hypopygium and the hecters* above it. (× 15.)

bands, when it occurs, usually affects the lower inner angles and mediad portion of the hind margins of the two halves of the bands affected, or, at any rate, the inner extremities of the two halves of the bands, so that, even when the bands are much obliterated, their outer extremities are always visible; seventh segment in ♀ with a more or less distinct indication of an interrupted clove-brown band at base; hypopygium of ♂ (Fig. 14) greyish ochraceous-buff, large as compared with that of *G. longipalpis*, Wied. (compare Figs. 14 and 15).

Legs.—Front femora on inside, middle and hind femora on outside more or less infuscated (mouse-grey or greyish clove-brown), outside of front femora also in some cases with a small

* See p. 14 (first paragraph and note *).

dark patch beyond middle ; a dark brown elongate blotch on under side of middle and hind femora near distal extremity ; middle and hind tibiae sometimes more or less infuscated on outer

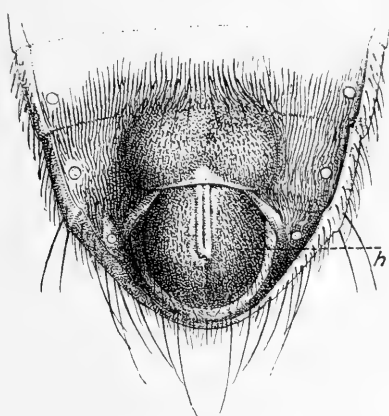


Fig. 15.

Distal portion of abdomen of *Glossina longipalpis*, Wied., ♂ (ventral aspect), showing (h) hypopygium and the hectors* above it. (× 15.)

side ; penultimate joint of hind tarsi narrowly pale at extreme base.

Wings faintly tinged with drab. *Squamae* waxen-white, with cream-coloured border and fringe (fringe of antisquama brownish). *Halteres* cream-coloured.

Glossina morsitans, form *submorsitans*, Newst.

Glossina submorsitans, Newstead, Annals of Tropical Medicine and Parasitology, Series T. M., Vol. IV, No. 3, p. 371 (December 20, 1910); Bulletin of Entomological Research, Vol. II, Part 1, p. 33, fig. 17, p. 34 (male genitalia) (April, 1911).

Relying chiefly on certain differences in the internal genital appendages of the male, Mr. Newstead has recently described this form as a *species* allied to the true *G. morsitans*, Westw.; but after making a minute external examination of the very large number of typical and other specimens of *G. morsitans*, Westw., received within the last few years by the British Museum (Natural History) from many different localities in Africa, and comparing with them the types of the supposed new species, which have been kindly presented to the National

* See p. 14 (first paragraph and note *).

Collection by its author, I am satisfied that it is impossible to regard *G. submorsitans*, Newst., as specifically distinct from *G. morsitans*, Westw., and that it is in reality nothing more than a form or race of the latter. As will shortly be shown, *G. morsitans* is the most widely distributed of all the Tsetse-flies, and it is, therefore, not surprising to find that even morphological characters are not absolutely identical in the case of specimens from localities situated at the opposite extremities of its area, and separated from one another by some thousands of miles. The form *submorsitans* has hitherto been found in West Africa and the Anglo-Egyptian Sudan, and it is of course possible that, e.g. a male from Northern Nigeria belonging to this form might be incapable of mating with a female of the typical race of *G. morsitans* from the Bechuanaland Protectorate. Still, if the area of *G. morsitans* could be traversed from end to end, starting from the Bechuanaland Protectorate or the North-Eastern Transvaal and proceeding to Northern Nigeria or the Anglo-Egyptian Sudan, it is not unreasonable to suppose that it would be found that the form *submorsitans* constitutes, as it were, one end of a chain of groups of interbreeding Tsetse-flies, of which the other extremity would be represented by typical *Glossina morsitans*, Westw.

As indicated in the description printed above, the dark bands on the abdomen of *G. morsitans* are subject to much individual variation as regards the extent to which they are developed. The *external* characters mentioned by Mr. Newstead as serving to distinguish his *G. submorsitans* from *G. morsitans*, Westw., which are entirely derived from the abdominal bands, have been carefully tested by examining the material in the National Collection, and comparing it both with the types of the form *submorsitans* and with typical specimens of *G. morsitans*, Westw., with the result that in each case the character selected has sooner or later proved unreliable and ultimately invalid.

DISTRIBUTION OF *G. morsitans*, Westw.

Glossina morsitans, Westw., once regarded as an exclusively South African species, is unquestionably the most widely distributed of existing Tsetse-flies, since its range extends from Senegambia (about 16° N.) in the north-west, to Southern Kordofan (about 12° N.) and Southern Abyssinia in the north-east, and thence southwards to the Bechuanaland Protectorate

(Lake Ngami district), the North-Eastern Transvaal, and Zululand. Although present knowledge is not sufficient to enable us to state whether *G. morsitans* exists in every country and Protectorate within the limits indicated, the species (besides occurring in the countries already mentioned) is certainly found in : the Gambia, French Guinea, the Gold Coast (Northern Territories), Togoland, Dahomey, Northern Nigeria,* the Congo Free State (Katanga District), the Bahr-el-Ghazal Province of the Anglo-Egyptian Sudan, the Uganda Protectorate, German East Africa, the Nyasaland Protectorate, Rhodesia (N.-E., N.-W. and S.), and Portuguese East Africa. Owing to limitations of space, it is unfortunately impossible to give details (localities, dates of capture, etc.) of the hundreds of specimens of this species received by the British Museum (Natural History) within the last eight years.

BIONOMICS.

Until well within the last decade, *G. morsitans* was almost the only Tsetse-fly of which the habits had ever been observed, and the very numerous references to "Tsetse" in the writings of elephant and other big game hunters, explorers, and pioneers in South and South Central Africa, from the time of R. Gordon Cumming (1850) down to the present day, refer almost exclusively to this species. It was to *G. morsitans* that the name "Tsetse" was originally, and indeed until a few years ago exclusively applied, while even now the popular designation is still largely used in its original and restricted sense. For the writing of an account of the habits of *Glossina morsitans* a mass of material lies ready to hand, and the statements available down to the year 1903 were duly summarised by the author in his

* In this survey no distinction is of course made between typical *G. morsitans*, Westw., and *G. morsitans* form *submorsitans*, Newst., or any intermediate forms or varieties. The types of *G. submorsitans*, Newst. (for the separation of which from *G. morsitans*, Westw., the present author, as pointed out above, is unable to find sufficient justification), are from N. Nigeria, and Newstead considers it probable that all West African Tsetse-flies hitherto regarded as *G. morsitans* will prove "on further examination" to be referable to his *G. submorsitans* (cf. Newstead, Ann. Trop. Med. and Parasitol., Series T. M., Vol. IV, No. 3, pp. 369-370, December 20, 1910). While it is true that the majority of West African specimens of *G. morsitans* in the British Museum (Natural History) may be regarded as belonging to the form *submorsitans*, Newst., the National Collection also possesses specimens from Senegambia, the Northern Territories, Gold Coast, and N. Nigeria (Kontagora), which in all external characters, except for the fact that the last joint of the middle tarsi is clove-brown only at the distal extremity, are typical *G. morsitans*, Westw.

'Monograph.'* In the present volume, however, the space available renders it out of the question to attempt a *résumé* of the published observations on this subject; while, in view of the fact that the Entomological Research Committee (Tropical Africa) is now endeavouring to collect and collate from reliable observers, resident on the spot, accurate statements concerning the bionomics of *G. morsitans*,† there is the less need for a summary based largely on the results of necessarily limited observation, and referring in some cases to an epoch since passed away. A few points may, however, be noted.

As indicated by the term "fly-belt," originally applied to *G. morsitans*, this species is usually confined to quite definite tracts, often of very limited extent. Within these "belts" the fly sometimes attacks human intruders in such numbers as to have been compared to a swarm of bees. Cover, usually in the shape of large trees with thick undergrowth, open thickets, or scattered, shady trees is essential to the existence of *G. morsitans*, which, like other species of Tsetse, is never found on the open, sun-scorched veld. Authorities like Mr. F. C. Selous, Sir John Kirk, and others (whose experiences, it should be pointed out, relate to the period before the buffalo was driven northward, or almost exterminated by rinderpest), write of *G. morsitans* occurring in swarms on the banks and "along the water's edge" of the Zambesi, Chobe, Rovuma and other rivers. Recent observers, on the other hand, such as Dr. L. Sander (in German East Africa), Sir Alfred Sharpe (in Nyasaland), and Mr. S. A. Neave (on the south-west shore of Lake Nyasa, and on the Luangwa River in North-Eastern Rhodesia), lay stress on the fact that, in their experience, *G. morsitans* evinces a dislike to, rather than a preference for, the immediate vicinity of water, whether river or lake, and is not infrequently met with at a considerable distance (half a mile or so) from any water.‡ In this connection it is not uninteresting to remember that the original specimens of *G. morsitans*, found by Vardon and Oswell in 1845, were obtained on the Siloquana Hills in the Northern Transvaal, between the Magalakeen or Nylstroom River and the Limpopo.§

* Cf. E. E. Austen, "A Monograph of the Tsetse-Flies," pp. 6-23 (1903).

† See Bulletin of Entomological Research, Vol. I, Part 2, pp. 147-149, and 152-153 (July, 1910).

‡ It may be noted that in Yola Province, Northern Nigeria, Dr. Dalziel has always found *G. morsitans* "out of sight of water," although near to it (see p. 44).

§ Cf. E. E. Austen, "A Monograph of the Tsetse-Flies," pp. 7, 83-84 (1903).

Glossina morsitans, indeed, is by no means confined to low-lying districts. Some three years ago, Mr. E. A. Copeman, at that time District Commissioner at Kasempa, forwarded to the Museum a number of specimens of this species taken by him in January, 1908, on the Congo-Zambesi watershed, Kasempa District, North-Western Rhodesia, at an altitude of from 5,000 to 5,500 ft. In Nyasaland, however, according to Sir Alfred Sharpe,* *G. morsitans* is "seldom found above 3,000 feet."

The idea, formerly generally entertained, that *G. morsitans* "appears to avoid the presence of man, and is rarely found in the vicinity of human habitations, or within the confines of a town or other settlement,"† is only partially true, since native villages in areas in which this species occurs are often infested by the fly.‡ Thus Mr. P. E. Hall, Native Commissioner, Lundazi, writing on "The Movements of *Glossina morsitans* in the Lundazi District, North-Eastern Rhodesia,"§ speaks of native villages (Nawalia and vicinity) which are "full of fly" at the present time, or in which *G. morsitans* was "a plague" some six or seven years ago. In the Katanga District of the Congo Free State, *G. morsitans* has been observed by Dr. Sheffield Neave to enter villages on a caravan-path infested with the fly, between the Lufira and Lualaba Rivers.||

Glossina morsitans feeds with avidity on the blood of almost any large mammal that comes in its way.¶ The old dispute as to the special dependence of this species upon the buffalo (*Bubalus caffer*), which has so often been alleged, still continues, and, in view of the enquiry now being prosecuted by the Entomological Research Committee,** anything like a final pronouncement upon the question would be premature. All that need here be said is that the available evidence upon the point is to a certain extent

* Bulletin of Entomological Research, Vol. I, Part 3, p. 174 (October, 1910).

† See Austen, "A Monograph of the Tsetse-Flies," p. 23 (1903).

‡ According to Sir Alfred Sharpe (*loc. cit.*), freedom from *G. morsitans* in the case of villages situated in fly-areas is due to the clearing of the surrounding bush in order to make food-gardens.

§ Bulletin of Entomological Research, Vol. I, Part 3, pp. 183-184, and sketch-map (October, 1910).

|| Cf. Sheffield Neave, M.R.C.P., M.R.C.S., British Medical Journal, April 25, 1908, p. 988.

¶ Like *G. brevipalpis* (see p. 94) the present species readily sucks the blood of wild pigs; in Nyasaland, according to Dr. H. Hearsey, P.M.O., Nyasaland Protectorate, *G. morsitans* was on one occasion seen to settle "literally in hundreds" on the carcass of a wart hog (*cf.* British Medical Journal, May 15, 1909, p. 1211).

** *Vide supra*, p. 54.

contradictory. Whereas it is quite possible that formerly, in Africa south of the Zambesi, this particular Tsetse-fly was specially associated with and supported by the buffalo, since both were found in the same places, and the buffalo in the region in question some five and thirty years ago far outnumbered all other game, the evidence of many reliable observers shows that, in other parts of Africa at the present day, *G. morsitans* is in no way specially dependent upon the buffalo or any other species of game.

Although by some observers stated to be most aggressive during the hottest hours, according to other authorities *Glossina morsitans* attacks human beings throughout the day, in addition to biting, like other Tsetse-flies, during part of the night, especially when there is a bright moon and the weather is warm.

REPRODUCTION AND PRELIMINARY STAGES.

Accurate observations on the reproduction and preliminary stages of *Glossina morsitans* are urgently needed. That this should be so is not a little surprising when it is considered that this Tsetse-fly may be said to have been a familiar insect ever since the species was described more than sixty years ago. In a letter published in "The Field," of September 28, 1907, Mr. R. L. Harger, late of North-Eastern Rhodesia, stated that he had often watched *G. morsitans* depositing its "eggs [*i.e.* larvae] in the damp soil thrown up by the digging of a trench" round his tent. The species of Tsetse used by Sir David Bruce in Zululand, in 1895-96, in the course of his epoch-making researches into the etiology of Nagana, now proves to have been *Glossina pallidipes*, Austen, to which the larvae and pupae described and figured in the "Further Report"* by the distinguished investigator referred to consequently belong. Harger's brief statement therefore represents all that has so far been published on the life-history of *Glossina morsitans*. No larvae of this Tsetse-fly have as yet reached the Museum, but during the preparation of this volume the author received from Mr. R. W. Jack, Government Entomologist, Salisbury, Rhodesia, a pupa-case which undoubtedly belongs to *G. morsitans* (see Figs. 5 c and 6 c, pp. 5 and 7), accompanied by the following letter, dated "Department of Agriculture, Salisbury (Rhodesia), 20th October, 1910."

* "Further Report on the Tsetse Fly Disease, or Nagana, in Zululand." By Surgeon-Major David Bruce, A.M.S. Ubombo, Zululand, 29th May, 1896 (London: Harrison and Sons. 1897). Pp. 2-3, Plates I and II.

"I am sending you an empty pupa-case, which I believe to be that of the common Tsetse-fly (*Glossina morsitans*). It was taken between the roots of a tree (*Ficus* sp. ?) on the banks of (sixty or seventy yards from) a dry stream in the low veld below the escarpment in the Lomagundi district, Southern Rhodesia, and east of the Hunyani River. I was at the time endeavouring to ascertain the breeding grounds of the common Tsetse, and the tree under which the pupa-case was found was in the middle of a well populated belt of 'fly.' The earth between the roots of the tree was of an easily-worked sandy nature, and rich in humus. Numerous pupa-cases of other Diptera and of Lepidoptera were present, but of living Dipterous pupae I was able to find none, nor was I able to discover any more cases, in a state of preservation sufficient for recognition, during twelve days' work in the 'fly' country. I may mention that the season on the low veld in that part is very late, and when I was there (October) no rain had fallen for several months. It is possible that living pupae may be common after the first rains." With his letter Mr. Jack kindly enclosed a photograph showing the roots of the *Ficus* tree, and the exact spot where the pupa-case was found.

As will be seen from the photographs on pages 5 and 7 (Figs. 5 C, 5 F, 6 C, 6 F), the pupa-case of *Glossina morsitans* is smaller than that of *G. palpalis* and neater in appearance; the tumid lips are also conspicuously smaller, and the notch between them lacks the characteristic *key-hole-like* constriction exhibited by the notch between the lips of the puparium of the latter species. The tumid lips are smaller than those of any other *Glossina-puparium* at present known. The specimen found by Mr. Jack measures 5.4 mm. in length, by 3 mm. in greatest breadth; these dimensions are much smaller than those of the pupa of *G. pallidipes* (see p. 62), while the size and shape of the tumid lips and the size of the intervening notch are very different (*cp.* Figs. 6 C and 6 D, p. 7).

AFFINITIES AND DISTINCTIVE CHARACTERS.

Glossina morsitans, Westw., with *G. pallidipes*, Austen (p. 58, Plate VI), and *G. longipalpis*, Wied. (p. 63, Plate VII), forms the *Glossina morsitans* group of species, in which the abdomen is conspicuously banded, while the first three joints of the hind tarsi are pale. Apart from all other characters, *G. morsitans* is sufficiently distinguished from both the other members of its group by the absence of a distinct fringe of fine hair on the front

margin of the third joint of the antennae, and the greater depth of the pale hind margins to the banded abdominal segments. Further distinctive characters from *G. pallidipes* are pointed out on page 63.

Glossina pallidipes, Austen.

(Plate VI.)

Glossina pallidipes, Austen, "A Monograph of the Tsetse-Flies," p. 87, Plate IV (1903).

♂, ♀.—Length, ♂ (11 specimens) 8·5 to 10·4 mm., ♀ (9 specimens) 9·75 to 11·25 mm.; width of head, ♂ just under 3 to 3·2 mm., ♀ 3 to 3·25 mm.; width of front at vertex, ♂ 0·5 to 0·6 mm., ♀ 0·8 to 1 mm.; length of wing, ♂ 8·6 to 9·4 mm., ♀ 9·5 to 10·25 mm.

Medium-sized or rather large species, closely resembling the West African G. longipalpis, Wied. (p. 63, Plate VII), but distinguishable owing to the coloration of the last two joints of the front and middle tarsi.—Front in ♂ very narrow; dorsum of thorax olive-grey, smoke-grey, or drab-grey, with the usual dark brown, longitudinal markings generally much reduced, broken up, and but little conspicuous; abdomen buff, dorsum with dark brown or clove-brown bands as shown in Plate VI; legs buff, last two joints of hind tarsi clove-brown, front and middle tarsi either entirely pale or, at most, last two joints of front tarsi faintly brownish at the tips, and last joint and distal half of penultimate joint of middle tarsi light brown—never so dark as to form a sharp contrast with the remaining joints.

Head cream-buff, face and jowls bright cream-coloured polinose, posterior surface light grey, ocellar triangle smoke-grey or drab-grey, sides of front (parafrontals) each with a dark brown elongate blotch, sometimes indistinct, a little below half way between level of ocellar spot and that of base of antennae; frontal stripe raw-sienna-coloured, upper fourth mummy-brown or brownish; ocellar spot slate-coloured, connected with clove-brown transverse band joining bases of vertical bristles; first and second joints of antennae (cf. Fig. 8, p. 12) dark brown, third joint light or dark mouse-grey, more or less buff at base, elongate and with a prominent distal extremity, front margin with a conspicuous fringe of fine hair of moderate length, arista cream-buff or buff, base of penultimate and lower margin of proximal

extremity of terminal joint dark brown, terminal joint elongate and tapering, with a prominent ridge on upper side at base, branched hairs numerous, twenty-two to twenty-eight in number; *palpi* cream-buff, yellowish smoke-grey above, slate-grey or dark greyish-brown at tips; *proboscis bulb* dark mummy-brown or clove-brown, raw-umber-coloured on each side, except as a rule at distal extremity.

Thorax.—Pleurae and pectus grey, mouse-grey, or dark grey in ♂, paler (smoke-grey or drab-grey) in ♀; scutellum cream-buff, upper surface with a well marked dark brown blotch, triangular in outline, on each side of middle line; apical scutellar bristles long in both sexes.

Abdomen.—Dorsum of second segment with a dark brown blotch on each side (sometimes indistinct or wanting), not extending to lateral or hind margins; *dark bands* on third to sixth segments inclusive *very deep* (i.e. on each segment the dark band, starting from front border, extends close to hind margin, thus confining the ground colour, apart from the median interspace, to a very narrow hind border); *each half of each dark band*, when fully developed, is *cut off squarely* at the median interruption, but in many specimens the inner extremities of the bands on the third and fourth segments are partially obliterated; posterior angles of second to sixth segments inclusive cream-coloured; seventh segment smoke-grey or drab-grey; hypopygium of ♂ ochraceous-buff, broadly oval in outline as seen from below.

Legs.—Inner surfaces of front femora, and usually also outer surfaces of middle and hind femora towards distal extremities more or less grey or greyish; middle femora sometimes with a mouse-grey streak on lower part of outer side, and middle and hind femora each with the usual elongate dark brown mark on under side near distal extremity.

Wings light drab-coloured, unicolorous. *Squamae* waxen white, with cream-coloured border. *Halteres* cream-coloured.

DISTRIBUTION OF *G. pallidipes*, Austen.

The area of distribution of *G. pallidipes*, which is the eastern representative of the West African *G. longipalpis*, Wied. (p. 63, Plate VII), includes the south-eastern and eastern portions of the African continent, and extends from Zululand at any rate to the northern boundary of the East Africa Protectorate. So far as at present known, in addition to the countries mentioned,

G. pallidipes occurs in Portuguese East Africa, the Nyasaland Protectorate, North-Eastern Rhodesia, German East Africa, and the Uganda Protectorate.

The particulars with reference to the specimens of this species at present contained in the British Museum (Natural History) are as follows:—

Zululand: 1 ♂, 3 ♀ ♀,* precise locality unknown, 1910 (forwarded by Sir C. J. R. Saunders, K.C.M.G.; presented by Colonel Sir David Bruce, C.B., F.R.S., A.M.S.); 1 ♂, 1 ♀, Mtunzini, 1910 (presented by Colonel Sir David Bruce). Portuguese East Africa: 3 ♂ ♂, 2 ♀ ♀, Maganja da Costa, Quelimane, February, 1911 (*Dr. J. F. Sant' Anna*—forwarded for determination by the Director, Sleeping Sickness Bureau). Nyasaland Protectorate: 1 ♂, Shire Highlands, caught in a locality where Tsetse-flies were supposed to be non-existent, 1893 (*Sir H. H. Johnston, G.C.M.G., K.C.B.*); 2 ♂ ♂, precise locality uncertain, but probably Lunyina River, Henga, 1895 (*Captain R. Crawshay*). North-Eastern Rhodesia: 1 ♂, Lake Mweru, 18–22. iii. 1892 (*Captain R. Crawshay*). German East Africa: 1 ♂, 3 ♀ ♀ (including the types of the species), Kilima Njaro, 1888 (*F. J. Jackson, C.B., C.M.G.*). Uganda Protectorate: 1 ♂, 2 ♀ ♀, Busoga, 1903, and 1 ♂, 1 ♀, precise locality unknown, June, 1909 (*Colonel Sir David Bruce, C.B., F.R.S., A.M.S.*); 4 ♂ ♂, 3 ♀ ♀, Kibero, Nile Province, between Nimule and Wadelai, June, 1906 (*the late Dr. W. A. Densham*). East Africa Protectorate: 1 ♀, Upper Sabaki River, 1890, and 1 ♂, “caught in Witu town,” 1891 (presented by the late British East Africa Company); 1 ♀, Witu Forest, 1895 (*the Sultan of Witu*; presented by the late W. S. Godfrey); 18 ♂ ♂, 2 ♀ ♀, Machakos, 1897 (received from the Tsetse-fly Committee of the Royal Society); 3 ♂ ♂, 1 ♀, Uganda Railway, 1897–1898 (*the late Vet.-Captain A. J. Haslam*); 1 ♀, Uganda Railway (*C. S. Betton*); 1 ♂, 2 ♂ ♂, Tsavo River, 1902 (received from Colonel Sir David Bruce, C.B., F.R.S., A.M.S.); 3 ♂ ♂, 2 ♀ ♀, Kibwezi, Simba, and near Nairobi, “in railway carriage” (*Dr. Moffat*, per Colonel Sir David Bruce); 11 ♂ ♂, 9 ♀ ♀, Kibwezi, 1903 (received from the Sleeping Sickness Commission, per Dr. D. Nabarro); 6 ♂ ♂, Gosha, Jubaland, October, 1904, “said by the natives to be deadly to cattle and camels” (*Bt. Major L. H. R.*

* One of these is gravid and contains an apparently full-grown larva, the tumid lips of which are visible through the delicate integument of the posterior extremity of the fly.

Pope-Hennessy, D.S.O.); 1 ♂, Voi, 19. iii. 1906 (*W. L. Slater*); 1 ♀, Kilindi, January, 1909 (received from R. J. Stordy).

The occurrence of *G. pallidipes* in the Mozambique district of Portuguese East Africa is recorded by Professor Laveran, who states, on the authority of M. G. Vasse, that in the region in question *G. pallidipes* is found at higher altitudes than *G. morsitans*.* In the East Africa Protectorate, however, where it is said to be more widely distributed than any of its congeners, *G. pallidipes* has not been observed at an altitude of more than 5,000 feet.† In the Uganda Protectorate, Dr. R. van Someren, writing from Fort Portal on January 10th, 1911, states that the present species occurs, in company with *G. morsitans*, Westw., in several localities in Toro.

BIONOMICS.

The late Dr. W. A. Densham, writing from Nimule on July 24th, 1906, with reference to *Glossina pallidipes* as observed and collected by him in the Nile Province, Uganda Protectorate, said: "Of thirteen specimens taken, nine were males and four females. The flies were found near and in a narrow belt of true forest at Kibero, between Nimule and Wadelai, in June, 1906. They were numerous along the native path, in long grass with scattered trees, for a quarter of a mile before reaching the forest. They attacked freely at 8.30 on a sunny morning, were easily caught with the hand, and were observed to bite through a worn blue service puttee. They were seen and caught along the native path after entering the forest, and for two miles the other side of the belt, which is only about 300 yards in width, occasional flies were seen until the village was reached. Half-an-hour after arrival two were captured by my boys in camp and brought to me. On returning from the village next day no flies were seen until nearing the forest, so that the 'occasional' flies mentioned above may all have been 'following' flies. If so, they follow much further than *G. palpalis*. There are many rhino, pig, and buffalo in the forest, and *Colobus* monkeys are numerous. There are no natives nearer than two miles, but a well-trodden path connects two villages, and passes through the Fly. The natives

* Cf. A. Laveran, *Comptes rendus des séances de l'Académie des Sciences*, t. cxliv, p. 551 (1907). That *G. pallidipes* also occurs in the littoral region of Portuguese East Africa is proved by the recent discovery of the species near Quelimane, by Dr. J. F. Sant' Anna (*vide supra*).

† Cf. Sleeping Sickness Bureau Bulletin, Vol. II, No. 13, p. 37 (January 10, 1910).

know of the fly, but do not consider it dangerous to animals. They keep sheep and goats, and drive them along this path. No cattle are kept for many miles round."

In the East Africa Protectorate, where, according to Dr. P. H. Ross, the species is most numerous in August and September, Dr. A. D. Milne, P.M.O., states that *G. pallidipes*, in company with *G. brevipalpis* and *longipennis*, attracted by lamplight frequently enters railway carriages when a train is waiting during the night at one of the stations in the fly-belt on the Uganda Railway, and thus may be carried for a distance of 150 miles or more.*

PRELIMINARY STAGES.

A comparison of the pupae obtained by Colonel Sir David Bruce in Zululand, and described and figured by the author in his "Monograph of the Tsetse-Flies," pp. 26-28, Fig. 7 (1903), with the pupa-case of *Glossina morsitans*, Westw., recently discovered by Mr. R. W. Jack at Lomagundi, Southern Rhodesia (see p. 57, and compare Figs. 6 D and 6 C, p. 7), conclusively shows that there can be no doubt that the former belong to *G. pallidipes*, Austen. The pupa of *G. pallidipes* then (Figs. 4, 5 D, 6 D), as represented by Sir David Bruce's examples (four specimens), is from 6.4 to 7 mm. in length, by 3.4 to 3.75 mm. in greatest width. The tumid lips, which are from 0.8 to 1 mm. long, and separated by a U-shaped notch (somewhat resembling but with straighter sides and fuller at the bottom than the notch in the case of the pupa of *G. fusca*, Walk.), are much larger than the lips of the pupa of *G. morsitans*, while the notch between them is about twice as wide as in the latter. The notch is quite different in shape from that exhibited by the pupa of *G. brevipalpis*, Newst. (compare Figs. 6 D and 6 A), and the inner edges of the distal portions of the lips are more rounded and less sharp than in the case of the pupa of either *G. brevipalpis* or *G. fusca*.

AFFINITIES AND DISTINCTIVE CHARACTERS.

Among the species of the *Glossina morsitans* group to which it belongs, *G. pallidipes* is distinguished from *G. morsitans*, Westw., *inter alia* by the presence of a distinct fringe of fine hair on the front margin of the third joint of the antennae, by the narrowness of the pale hind margins to the banded

* Cf. Sleeping Sickness Bureau Bulletin, Vol. II, No. 13, p. 37 (January 10, 1910).

abdominal segments, and by the coloration of the last two joints of the front and middle tarsi, as described in the diagnosis printed in italics above. In the male sex it is distinguished by the narrower front, and in both sexes *G. pallidipes* may easily be separated from *G. morsitans* by the shape of the third joint of the antennae, which in the former species is long and narrow, with the distal extremity pointed and (especially in the female) conspicuously turned forwards; in *G. morsitans* the third joint of the antennae is shorter and much broader (about half as broad again as in *G. pallidipes*), and darker towards the tip, which is blunter and not so much turned forwards; the *arista* is also shorter in the other species mentioned than in *G. pallidipes*.*

From *G. longipalpis*, Wied., *G. pallidipes*, which is as a rule a distinctly larger species, is distinguishable in both sexes by the absence of sharply defined dark tips to the last two joints of the front and middle tarsi; as regards the males, even though the front and middle tarsi be wanting, a male of *G. pallidipes* can be distinguished from a male of *G. longipalpis* by the front being distinctly narrower at the vertex than anteriorly, since the inner margins of the eyes converge above, whereas in *G. longipalpis* the front is of the same width or practically so throughout.†

Glossina longipalpis, Wied.

(Plate VII.)

Glossina longipalpis, Wiedemann, "Aussereuropäische zweiflügelige Insekten," Zweiter Theil, p. 254, Taf. ix, figs. 10, *a*, *b*, *c* (1830); Macquart, Hist. Nat. des Ins. Diptères, T. ii, p. 245 (1835), and Dipt. Exot., T. ii, 3, p. 113, Tab. 14, fig. 1 (1843); Lichtwardt, Beiträge zur Kolonialpolitik und Kolonialwirtschaft, iv Jahrg., Heft 9, p. 264, *et seq.*, figs. 1, 9, 10, *etc.* (1903); Austen, "A Monograph of the Tsetse-Flies," p. 90, Plate V (1903).

♂, ♀.—Length, ♂ (10 specimens) 8·4 to 9 mm., ♀ (6 specimens) 9 to 10 mm.; width of head in both sexes 2·75 to 3 mm.;

* To facilitate comparison, the antennae should be removed with a needle or the point of a fine scalpel, mounted in glycerine and examined under a lens.

† Mr. Newstead's recently published conclusion that *Glossina pallidipes*, Austen, is merely a "colour variety" of *G. longipalpis*, Wied. (*cf.* Annals of Tropical Medicine and Parasitology, Series T.M., Vol. IV, No. 3, p. 371—December 20, 1910), has since proved to be erroneous, and due to the specimen used for examination having been incorrectly determined. The study by Mr. Newstead of further material submitted to him by the author

width of front at vertex, ♂ 0.6 mm., ♀ 0.75 mm.; length of wing, ♂ 8 to 8.6 mm., ♀ 8.75 to 9.25 mm.

Precisely similar to Glossina pallidipes, Austen (p. 58, Plate VI), in general appearance, but distinguished by the last two joints of the front and middle tarsi having sharply defined and conspicuous clove-brown tips, and in the male sex by the front not being distinctly narrower at the vertex.

Head cream-buff, face and jowls bright cream-coloured pollinose, posterior surface smoke-grey, ocellar triangle smoke-grey or drab-grey, sides of front (parafrontals) each with a dark brown blotch, as in *G. pallidipes*; *frontal stripe* tawny ochraceous or ochraceous anteriorly, mummy-brown posteriorly; *ocellar spot* and band joining bases of vertical bristles as in *G. pallidipes*; first and second joints of *antennae* buff, dark brown on inner side, third joint mouse-grey, buff at extreme base, front margin fringed as in *G. pallidipes*, arista coloured as in *G. pallidipes*, but terminal joint without so prominent a ridge on upper side at base and consequently not so tapering, branched hairs twenty-one to twenty-three in number; *palpi* as in *G. pallidipes*; *proboscis bulb* dark sepia.

Thorax.—Dorsum olive-grey or dark olive-grey, with markings as in *G. pallidipes*; pleurae, pectus and scutellum as in *G. pallidipes*; apical scutellar bristles long in both sexes.

Abdomen.—Coloration and markings precisely the same as in *G. pallidipes*, inner extremities of interrupted bands on third and following segments often more or less obliterated.

Legs.—Coloration, except in case of last two joints of front and middle tarsi, the same as in *G. pallidipes*.

Wings, squamae, and halteres as in *G. pallidipes*.

DISTRIBUTION OF *G. longipalpis*, Wied.

Although essentially a West African species, the range of which extends to the north-west as far as Senegal,* *Glossina longi-*

shows that males of *G. pallidipes* and *longipalpis* are readily distinguishable by means of their genital appendages (cf. Bulletin of Entomological Research, Vol. II, No. 1, pp. 30-32, Fig. 15, April, 1911).

* For records of the occurrence of *G. longipalpis* in Senegal, see Laveran, Comptes Rendus des Séances de l'Académie des Sciences, T. cxliv, p. 547 (1907). For records from French Guinea and French Congo, see Laveran, *ibid.*, T. cxxxix, p. 659 (1904), and T. cxli, p. 931 (1905), respectively.

palpis is found at least as far to the south-east as the Katanga district of the Congo Free State,* *i.e.* the south-eastern corner of Belgian Congo. As stated in the author's "Monograph,"† the Museum collection contains a male of this species, which, if its label may be trusted, was collected by Dr. John Kirk (now Sir John Kirk, G.C.M.G., K.C.B., F.R.S.) on the Zambesi. Specimens of *Glossina palpalis*, Rob-Desv., and *G. brevipalpis*, Newst., in the possession of the Museum, also bear similar labels, and according to a recently published extract from a letter from Sir John Kirk ‡ all the Tsetse-flies brought home by him, which were collected so long ago as 1864, were obtained in the valley of the Zambesi, between Tete and the Victoria Falls. Even assuming that no mistake has been made in the labelling of this specimen, it by no means follows that *G. longipalpis* is still to be found on the Zambesi, since we know, for instance, that *Glossina morsitans*, Westw., has disappeared from the Victoria Falls, where at one time it abounded. Apart from statements relating to Sir John Kirk's solitary specimen, there are no records or other evidence, recent or otherwise, of the occurrence of *G. longipalpis* south of the Congo Free State; therefore, until indisputable proof to the contrary is received, it will be safer to regard Katanga as forming the southern limit of the range of *G. longipalpis*, so far as is at present known. The authenticated area of distribution of *Glossina longipalpis*, which, as already stated, is a West African species, extends then from Senegal to the Katanga district of the Congo Free State.

The particulars with reference to the specimens of *G. longipalpis* (other than Sir John Kirk's example) now in the British Museum (Natural History) are as follows:—Gold Coast: 2 ♂ ♂, 4 ♀ ♀, Dodowah (30 miles from Accra), "very numerous after the break of the rains," May, 1906 (*C. A. Laing*); 1 ♂, Volta River, March, 1908 (*G. C. Dudgeon*). Northern Nigeria: 1 ♂, 3 ♀ ♀, Akwacha, Bassa Province, July and August, 1906 (*Dr. G. J. Pirie, W.A.M.S.*); R. Niger, Ilorin Province, near Jebba, October, 1909 (*Dr. C. W. McLeay, W.A.M.S.*); 1 ♂, Baro, R. Niger, Nupe Province, 1909 (*Dr. E. A. Chartres, W.A.M.S.*). Southern Nigeria: 5 ♂ ♂, 2 ♀ ♀, Igbassa, Ijami, between Ijami

* *G. longipalpis* is recorded from the Upper Luapula River by Newstead and Todd (Annals of Tropical Medicine and Parasitology, Series T. M., Vol. I, No. 1, p. 72 (February 1, 1907)); also from Lukafu, July, 1903, by Laveran, Comptes Rendus des Séances de l'Académie des Sciences, T. cxxxix, p. 662 (1904), and T. cxli, p. 932 (1905).

† E. E. Austen, "A Monograph of the Tsetse-Flies," p. 92 (1903).

‡ Cf. Sleeping Sickness Bureau Bulletin, No. 3, p. 125 (January, 1909).

and Meko, and between Meko and Igbassa (all localities in Western Province), April, 1908 (*G. C. Dudgeon*); 1 ♂, 1 ♀, Sebe, 1 ♂, between Olebakin and Ifon, May, 1908 (*G. C. Dudgeon*).

It will have been noticed that the Museum has as yet received no specimens of *G. longipalpis* from Sierra Leone, where the type of the species (and therefore also of the genus *Glossina*) was obtained by the Swedish botanist Afzelius in the closing years of the eighteenth century.

BIONOMICS.

Like other members of the *Glossina morsitans* group, to which it belongs, *G. longipalpis* would appear not to be so closely restricted to the immediate vicinity of water as the species belonging to the *Glossina palpalis* group often, although not invariably, are. A field-note attached by Mr. G. C. Dudgeon to a ♂ and ♀ taken by him near Ijami, Southern Nigeria, in April, 1908, as mentioned above, states that they were caught in bush, where there was no water and also no game, with the exception of small antelope; at Sebe, Southern Nigeria, where Mr. Dudgeon found *G. longipalpis* in May, 1908, game was represented by the West African buffalo (*Bubalus nanus*). Writing to the author on April 8th, 1907, with reference to *G. longipalpis* as found by him in Northern Nigeria, Dr. G. J. Pirie said: "During the dry season at Akwatcha (twenty-five miles inland from the River Benue), Bassa Province, *Glossina longipalpis* are very few, while during the rains they are rather numerous, especially in the desner bush-patches along the small water-courses." Dr. Pirie added that "trypanosomiasis both of animals (horses and dogs) and of man exists at Akwatcha, especially in the rainy season from May to October," and that he had searched carefully for *Glossina palpalis*, but, so far as he could judge, without success.

At a certain spot on the Ouémé River, in Dahomey, where both *G. longipalpis* and *palpalis* occur, the latter species, according to Roubaud, is for the most part confined to the immediate vicinity of the water and to the belt of forest fringing the banks; *G. longipalpis*, on the other hand, which is scarcely to be found in the actual *palpalis* zone, predominates in the bush bounding the forest on the outer side, and is there preyed upon by a Hymenopteron belonging to a new species of the genus *Bembex*.*

* Cf. E. Roubaud, Comptes Rendus des Séances de l'Académie des Sciences, T. 151, No. 8, p. 506 (August 22, 1910).

In Central Dahomey, where, according to Roubaud, the sexes show a well-marked separation or localisation, *G. longipalpis* occurs in the vicinity of streams and large rivers. "The males are found only in the clumps of brushwood along the inner edge of the forest belt near streams; the females are to be met with in open clearings where there are acacias and mimosas." Roubaud states that in Dahomey *G. longipalpis* is abundant during the rains, but seems to disappear almost completely in the dry season, especially after the bush is burnt; its habitat is more restricted than that of either *G. tachinoides* or *G. palpalis*, both of which are also found in the same district, and it mingles with its congeners less than does either of the two species mentioned. Like *G. palpalis* and *tachinoides*, *G. longipalpis* in Dahomey, according to Roubaud, lives chiefly at the expense of wild mammals, and accompanies big game in its movements; the present species especially frequents paths newly trodden by hippopotamus and elephant.*

In the Western Province of Ashanti, according to Kinghorn, *G. longipalpis* "is essentially an open country fly and is not found in the forest belt."†

REPRODUCTION AND PRELIMINARY STAGES.

Glossina longipalpis in Dahomey was never observed by Roubaud to copulate in captivity. Females kept by the observer referred to at 25° C. (77° F.) deposited a larva at intervals of about ten days, and the pupal stage, at an average temperature of from 24° to 25° C. (75·2° to 77° F.), was found to last from twenty-six to thirty-five days.‡

AFFINITIES AND DISTINCTIVE CHARACTERS.

In the *Glossina morsitans* group, to which, as already stated, *G. longipalpis* belongs, the present species can be distinguished from *G. morsitans*, Westw., *inter alia* by some of the same characters as those serving to distinguish *G. pallidipes*, Austen, from the species mentioned (see p. 62), *i.e.* by the

* Cf. E. Roubaud, "Études biologiques sur les Glossines du moyen Dahomey": Comptes Rendus des Séances de l'Académie des Sciences, T. 152, No. 7, p. 406 (Février 13, 1911).

† Cf. Sleeping Sickness Bureau Bulletin, Vol. 3, No. 25, p. 136 (March 14, 1911).

‡ Roubaud, *loc. cit.*, p. 407.

presence of a distinct fringe of fine hair on the front margin of the third joint of the antennae, and by the narrowness of the pale hind margins to the banded abdominal segments. The similarity in general appearance between *Glossina longipalpis* and its eastern representative *G. pallidipes* has been referred to in the diagnosis printed in italics above, where the external characters by which the two species may be distinguished are also pointed out; it may be added that *Glossina longipalpis* is usually a smaller insect than *G. pallidipes*, and that the specific differences presented by the male genital appendages have quite recently been elucidated by Mr. Newstead.

CHAPTER VI.

THE GLOSSINA FUSCA GROUP.

SYNOPSIS OF SPECIES.

1. Third joint of antennae fringed with fine hair on anterior and posterior margins; fringe on anterior margin conspicuous under a hand-lens magnifying 15 diameters (nominal), when head is viewed in profile 2
- Third joint of antennae with fringe of fine hair on anterior margin so short as to be scarcely noticeable under a hand-lens magnifying 15 diameters (nominal), when head is viewed in profile (longest hairs in fringe in length not exceeding one-sixth of width of third joint); palpi long and slender 3
2. Longest hairs in fringe on front margin of third joint of antennae, in length equal to from one-fourth to one-third (not exceeding one-third) of width of third joint; palpi of moderate length *tabaniformis*, Westw.
- Longest hairs in fringe on front margin of third joint of antennae in length equal to from one-half to three-fourths of width of third joint; palpi noticeably long and slender *nigrofusca*, Newst.
3. Pleurae drab-grey or isabella-coloured, hind coxae buff or greyish-buff *fusca*, Walk.
- Pleurae dark grey, hind coxae mouse-grey. *fuscipleuris*, sp. nov.

Glossina fusca, Walk.

(Plate VIII.)

Stomoxys fuscus, Walker, List Dipt. Ins. in Coll. Brit. Mus., Part III, p. 682 (1849).

Glossina fusca, Walker, "Entomologist," Vol. VI., p. 328 (1873) (*nec* Austen, Monograph of the Tsetse-Flies, pp. 95-97, Plate VI (1903)); Newstead, Annals of Tropical Medicine and Parasitology, Series T. M., Vol. IV, No. 3, pp. 370, 373 (December 20, 1910).

♂, ♀.—Length, ♂ (12 specimens) 9·6 to 11·6 mm., ♀ (24 specimens) 10·5 to 11·8 mm.; width of head, ♂ 3 to

3.25 mm., ♀ 3.2 to 3.4 mm.; width of front at vertex, ♂ 0.6 mm., ♀ 0.6 to just under 1 mm.; length of portion of palpi projecting beyond margin of buccal cavity, ♂ 3.2 to 3.6 mm., ♀ 3.6 to 4.5 mm.; length of wing, ♂ 10 to 11 mm., ♀ 10.8 to 12.6 mm.

Large, dark brown, dark-winged species, with long and slender palpi, and without distinct dark bands on the abdomen, which is lighter at the base; in general appearance very closely resembling (Glossina nigrofusca, Newst. (p. 77), but distinguishable in both sexes by the third joint of the antennae not being clothed with long

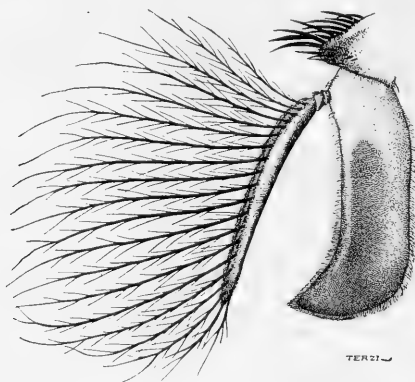


FIG. 16.
Antenna of *Glossina fusca*, Walk. (× 30.)

and fine pale hair, forming a conspicuous fringe down the anterior and posterior edges.

Head buff or cream-buff, posterior surface smoke-grey, face, sides of front, and posterior orbits below yellowish pollinose; frontal stripe dark brown or mummy-brown, its anterior extremity mummy-brown or russet-brown; ocellar spot dark brown, connected with dark brown transverse band joining bases of vertical bristles; antennae partly buff, partly brown or mouse-grey, second joint dark brown at least on inner surface, third joint (tip of which is prominent) buff at base and on posterior margin, elsewhere dark brown or mouse-grey, viewed in profile fairly broad, not clothed with long and fine pale hair, fringe of minute hairs on front and hind margins in length not exceeding one-sixth of breadth of third joint (cf. Figs. 16, 19 and 18), arista

buff, terminal joint stout, dark brown at base beneath, branched hairs seventeen to twenty in number; *palpi* buff, mouse-grey on upper portion of outer surface, and dark brown at tips; *proboscis bulb* buff-yellow or orange-buff, often with a dark brown blotch on its upper lateral margin on each side.

Thorax.—Dorsum mouse-grey, with dark brown markings of the usual type, as shown in Plate VIII; pleurae and pectus drab-grey or isabella-coloured pollinose, sternopleurae with a black or clove-brown blotch (covered and partially obscured by yellowish pollen) on each side of median ventral line, between front and middle coxae; upper surface of scutellum dark brown, impressed median line and under surface buff, apical scutellar bristles of ♀ long or fairly long.

Abdomen.—Dorsum of first and second segments light mummy-brown or dull cinnamon, dorsum of remaining segments dark brown; basal angles, lateral margins, and hind border of second segment usually infuscated; third and fourth segments often with a paler area (of same colour as median portion of second segment) in centre, though their hind borders are still dark brown; posterior angles and lateral margins of third to sixth segments inclusive yellowish-grey pollinose; seventh segment yellowish-grey or brownish-grey pollinose; hypopygium of ♂ (cf. Fig. 17, A, p. 76) isabella-coloured, greyish-buff, or greyish fawn-coloured.

Legs buff or ochraceous-buff, front femora usually with a more or less well-marked mouse-grey or greyish-brown streak on inner side, middle and hind femora often with a similar streak on outer side of their distal halves, and frequently also with the usual dark brown or mummy-brown elongate blotch on their under side near distal extremity; hind tibiae usually with a more or less distinct dark brown or brown partial ring round middle, and middle tibiae generally with a vestige of a corresponding ring; tips of hind tibiae on outer side and upper side of first three joints of hind tarsi mummy-brown; short, felt-like hair clothing tips of hind tibiae on inner side, and also clothing under side of first three joints of hind tarsi, shining tawny ochraceous; tips of last two joints of front and middle tarsi dark brown, last two joints of hind tarsi entirely clove-brown.

Wings dull sepia-coloured, fairly dark; alula paler (almost hyaline); bent-up portion of fourth longitudinal vein, except at each end, paler; anterior transverse vein, although thicker at its extremity in contact with the third longitudinal vein, not so

noticeably incrassate as is the anterior extremity of the same transverse vein in the wing of *G. brevipalpis*, Newst.; posterior transverse vein and portion of fourth longitudinal vein immediately beyond it sometimes slightly infuscated. *Squamae* semi-hyaline, fringe long, yellowish. *Halteres* cream-buff.

Since the type of the present species is damaged, and of unknown provenance, the re-description printed above has been prepared from a ♂ from Masaku, Ronietta District, Sierra Leone Protectorate, 16. ix. 1909 (*Dr. J. J. Moore, W.A.M.S.*), and a ♀ from Boje, Liberia, 21. v. 1909 (*Major A. Pearce, R.A.M.C.*).

DISTRIBUTION OF *G. fusca*, Walk.

The specimens available for examination show that the range of the true *G. fusca*, Walk., as described above, extends at any rate from the Sierra Leone to the Uganda Protectorates, although no examples of the species have as yet been received at the British Museum (Natural History) from French Guinea, the French Ivory Coast, Togoland, Dahomey, Cameroon, French Congo, or the Congo Free State. There is at present no evidence that the species occurs in the East Africa Protectorate, German East Africa, the Nyasaland Protectorate, Portuguese East Africa, or Rhodesia.

The following are the data with reference to the specimens examined, other than those already mentioned:—

Sierra Leone Protectorate: 1 ♂, Warima, 9. ix. 1905, and 2 ♂♂, 3 ♀♀, Robarri, 9, 10. ix. 1905 (*Captain—now Major—H. W. Grattan, R.A.M.C.*); 1 ♀, Rotofunk, September, 1906 (*F. A. G. Fido*); 1 ♂, Dodo, 15. iv. 1909, 1 ♀, Gongo, 11. iv. 1909 (*Major A. Pearce, R.A.M.C.*); 1 ♂, Myopo, 15. ix. 1909, 2 ♀♀, Yelli and Moyamba, 13, 23. ix. 1909, 1 ♀, doctor's quarters, Moyamba, 1. x. 1909, 4 ♀♀, Monpeh, Matotoka, Maboön, and Connabai, 22–29. i. 1910—all localities in Ronietta District (*Dr. J. J. Moore, W.A.M.S.*). Liberia: 1 ♂, Dombolo, 23. iii. 1909, “taken on an elephant,” 1 ♀, near Da, 20. iv. 1909, 1 ♂, Da, 25. iv. 1909, 1 ♀, on road between Heye and Gondo, 2. v. 1909, 1 ♀, near Bukei, 13. v. 1909, 1 ♂, Simbek, 16. v. 1909, “caught buzzing round a candle, about 8.30 P.M.,” 1 ♂, Simbek, 18. v. 1909 (*Major A. Pearce, R.A.M.C.*). Gold Coast Protectorate: 1 ♀, Fumsu, Ashanti, 14. xii. 1907, “caught in tent, 5.45 P.M.” (*Dr. W. M. Graham, W.A.M.S.*). Northern Nigeria: 2 ♀♀, near rest-house, Ife,

and in bush between Poinia and Allu, 9. xi. 1910 (— *Walton*). Southern Nigeria: 1 ♂, Okigwi, 30. v. 1910 (*J. J. Simpson*); 1 ♂, Ikom, Cross River, Eastern Province, 6. vii. 1910 (*Dr. W. S. Clark*); 1 ♂, Oban, 17. viii. 1910, and 1 ♀, Cross River, Eastern Province, 1910 (*J. H. J. Farquhar*). Uganda Protectorate: 1 ♀, Bugoma Forest, 35 miles west of Hoima, close to shore of Lake Albert, 1905, "caught biting native" (*Captain A. C. H. Gray, R.A.M.C.*); 1 ♀, north-east side of Lake Edward, 1906 (received from Dr. A. D. P. Hodges, P.M.O.); 1 ♀ (with its puparium), bred from pupa found near south-east corner of Lake Albert, 5. xii. 1906 (*Dr. A. G. Bagshawe*).

BIONOMICS.

Dr. A. Kinghorn, who has observed *G. fusca* in Ashanti, states that as regards its habitat this species resembles *G. longipalpis* much more closely than *G. palpalis*. "It was usually found just at the fringe of patches of bush, and it was rare to catch more than one specimen or at most a couple. It feeds not uncommonly at night, and may be met with in dull or rainy weather." Specimens of *G. fusca* once or twice settled on Dr. Kinghorn "on a pitch-black, rainy night."*

PRELIMINARY STAGES.

All that can at present be said as to the life-history of *G. fusca*, Walk., relates to the pupal stage. On December 5th, 1906, Dr. A. G. Bagshawe (now Director of the Sleeping Sickness Bureau) found in a dry gully in the vicinity of the Mizizi River, near the south-east corner of Lake Albert, Uganda Protectorate, a number of empty puparia belonging to the present species, together with one pupa from which the fly referred to above subsequently emerged. These specimens, which were afterwards presented to the National Collection by Dr. A. D. P. Hodges, P.M.O., Uganda Protectorate, show that the pupa of *G. fusca* measures some 8 mm. in length, by about 4.5 mm. in greatest breadth, and consequently agrees in its dimensions with the pupa of *G. brevipalpis*, Newst.† The pupae of these two species can, however, at once be distinguished by the shape of the notch between the tumid lips or anal protuberances (*cp.* Figs. 6 B and 6 A).

* Sleeping Sickness Bureau Bulletin, Vol. 3, No. 25, p. 136 (March 14, 1911).

† See p. 96.

If a pupa of each species be placed side by side in the position shown in the figures, that is to say with the tumid lips directed upwards, and the more convex surface of what is now the upper extremity of the pupa towards the observer, in such a way that the tumid lips are viewed exactly in profile, it will be seen that whereas the notch between the lips of the pupa of *G. brevipalpis* is relatively wide and shallow, looking something like a wide V,* the corresponding notch in the case of the pupa of *G. fusca* is narrower, deeper, and distinctly U-shaped. The edges of the tumid lips are also sharper in the latter than in the former species, in which the lips have a decidedly blunter and less cleanly-cut appearance. The breadth of the posterior extremity of the pupa (as measured by a horizontal line drawn through the tumid lips when the pupa is in the position indicated) is greater in *G. fusca* than in *G. brevipalpis*, and in the same position the outer margins of the lips in the former are more convex.

AFFINITIES AND DISTINCTIVE CHARACTERS.

With *Glossina nigrofusca*, Newst. (see below, p. 77), *G. fuscipleuris*, Austen (p. 75), and *G. tabaniformis*, Westw. (p. 81), *G. fusca* forms an easily recognisable group (which may be termed the *Glossina fusca* group) of Tsetse-flies, characterised by large size, a general dark brown coloration of the body without conspicuous bands on the abdomen, and dusky wings. In *G. fusca*, *nigrofusca*, and *fuscipleuris* the palpi (and proboscis) are noticeably longer than in any other species of the genus; in *G. tabaniformis* they are of approximately the same length as in *G. brevipalpis*, Newst. From *G. nigrofusca* and *tabaniformis*, *G. fusca* can at once be distinguished by the fringe of minute hairs on the front margin of the third joint of the antenna, instead of being easily visible when the antenna is examined under a platyscopic lens magnifying 15 diameters (nominal), and in length at least equal to one-fourth of the width of the third joint, being so short as to be scarcely noticeable under a lens of the kind mentioned:† the length of the palpi in *G. fusca* will also assist in distinguishing it from *G. tabaniformis*. The coloration of the pleurae (which are drab-grey or isabella-coloured instead of dark grey) and of the hind coxae (which are buff or greyish-buff instead of mouse-grey), as well as the greater thickness of the black hairs fringing the

* See p. 96.

† Cf. figs. 18, 19, 16.

posterior edge of the hind coxae, will serve to distinguish *G. fusca* from *G. fuscipleuris*, with regard to which further distinctive characters will be found under the heading of the latter.

Glossina fuscipleuris, sp. nov.

(Fig. 17, B.)

Glossina fusca, Austen (*nec* Walker), Trans. Zool. Soc. London, Vol. XIX, Part 1, p. 100 (October, 1909).

♂.—Length (1 specimen) 10·25 mm.; width of head 3 mm.; width of front at vertex just over 0·5 mm.; length of portion of palpi projecting beyond margin of buccal cavity 3·6 mm.; length of wing 10·4 mm.

Dusky species, allied to and resembling G. fusca, Walk., but distinguished by the pleurae being dark grey instead of drab-grey or isabella-coloured, by the hind coxae being mouse-grey instead of buff or greyish-buff, and by the black hair fringing the posterior margin of the hind coxae below being distinctly longer and finer.*

Head isabella-coloured, *face* and sides of front shimmering yellowish pollinose, posterior surface mouse-grey; *frontal stripe* dark brown; *ocellar spot* of same colour as frontal stripe, transverse band connecting bases of vertical bristles darker; *antennae* clove-brown, third joint dull cream-buff at base, without a conspicuous fringe of fine hair, arista buff, dark brown beneath, branched hairs nineteen in number in typical specimen; *palpi* dark mouse-grey on outer side, darker at tips, extreme base buff; *proboscis-bulb* yellowish, with a dark brown blotch on its upper lateral margin on each side.

Thorax.—General coloration of dorsum clove-brown, owing to usual longitudinal markings being well developed but not sharply defined; humeral calli and space on front margin on each side of admedian stripes olive-grey, interspaces between clove-brown longitudinal markings elsewhere light mouse-grey; pectus of same colour as pleurae; scutellum as in *G. fusca*.

Abdomen.—First segment buff; dorsum of second segment raw-umber-coloured, brownish at sides and on hind margin; dorsum of third to sixth segments inclusive clove-brown, lateral margins

* Cf. p 69 and Plate VIII.

and posterior angles smoke-grey ; seventh segment smoke-grey pollinose, central area mouse-grey ; hypopygium drab, viewed from below more oval in outline (less flattened at the sides) than that of *G. fusca*, Walk. (*cf.* Fig. 17).

Legs raw-sienna-coloured ; upper surface of femora dusky (dark grey or greyish-brown) ; middle and hind tibiae with an incomplete dark brown ring round centre ; distal halves of last two joints of front and middle tarsi dark brown, remainder of last joint of middle tarsi brownish ; last two joints of hind tarsi clove-brown, third joint of hind tarsi dark brown (less dark than

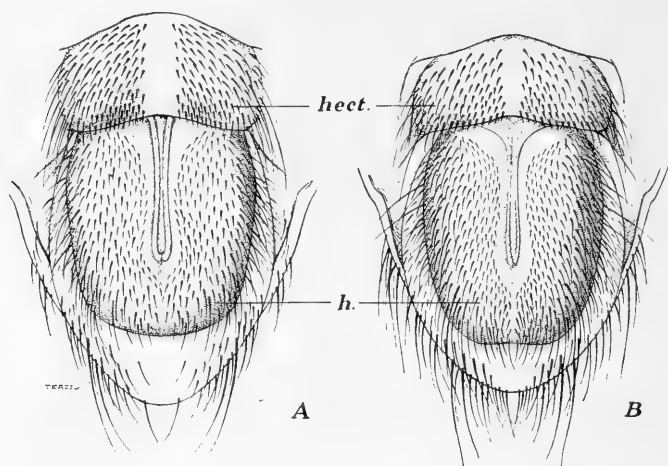


FIG. 17.

Distal extremity of ♂ abdomen of (A) *Glossina fusca*, Walk., and (B) *G. fuscipleuris*, sp. nov. (ventral aspect), showing (h) hypopygia and (hect.) hectors.* ($\times 15$.)

last two joints), second joint of hind tarsi brown, first joint of hind tarsi brownish above.

Wings dull sepia-coloured, fairly dark ; extremity of anterior transverse vein in contact with third longitudinal vein conspicuously incrassate ; alula paler than remainder of wing, nearly hyaline. *Squamae* dusky, of same colour as membrane of wing ; fringe of *squamae* brownish. *Halteres* cream-buff.

The typical specimen of this species is a ♂ in the British Museum (Natural History) from the Eturi Forest, north-eastern Congo Free State, between Irumu and Avakubi, alt. 2,000 ft., Oct. 1906 (*Hon. Gerald Legge* and *A. F. R. Wollaston*),—collected during the Ruwenzori Expedition, 1905–1906.

* See p. 14 (first paragraph and note *).

DISTRIBUTION OF *G. fuscipleuris*, sp. nov.

Since the type is the only example of *G. fuscipleuris* yet received, all that can at present be said as to distribution is that the species occurs in the forest region in the north-east of the Congo Free State.

BIONOMICS.

Unknown.

AFFINITIES AND DISTINCTIVE CHARACTERS.

Mention has already been made of the fact that this species belongs to the *Glossina fusca* group.* From *G. fusca* itself, which is its nearest ally, *G. fuscipleuris* may be distinguished by the characters afforded by the pleurae, hind coxae, and hypopygium, as noted in the diagnosis and description printed above. From *G. nigrofusca*, Newst.,† and *G. tabaniformis*, Westw.,‡ *G. fuscipleuris*, apart from its smaller size, differs in the third joint of the antennae not being conspicuously fringed with fine hair; from *G. tabaniformis* the present species may also be distinguished by the (at least relatively) greater length of its palpi.

***Glossina nigrofusca*, Newst.**

(Fig. 18.)

Glossina nigrofusca, Newstead, Annals of Tropical Medicine and Parasitology, Series T. M., Vol. IV, No. 3, p. 370 (December 20, 1910).

Glossina grossa, Newstead, *ibid.*, p. 373 (*nec* Bigot).

♂, ♀.—Length, ♂ (2 specimens) 12·4 mm., ♀ (2 specimens) 12·2 mm.; width of head, ♂ 3·4 to 3·75 mm., ♀ 3·75 mm.; width of front at vertex, ♂ 0·6 to just under 1 mm., ♀ 1 mm.; length of portion of palpi projecting beyond margin of buccal cavity, ♂ 4 to 4·4 mm., ♀ 4·8 mm.; length of wing, ♂ 11 to 11·75 mm., ♀ 12·75 mm.

Resembling *Glossina fusca*, Walk. (see p. 69 and Plate VIII), especially in the ♀ sex, *but distinguishable* inter alia *by the third joint of the antennae being clothed with long and fine pale hair*,

* Cf. p. 74.

† See below.

‡ P. 81.

forming a conspicuous fringe down the anterior and posterior edges (cf. Figs. 18 and 16), the length of the fringe on the anterior edge being equal to from one-half to three-fourths of the width of the third joint.

Head greyish-buff, posterior surface smoke-grey or mouse-grey; *frontal stripe* mummy-brown, paler anteriorly; *ocellar spot* and dark brown transverse band joining bases of vertical bristles as in *G. fusca*; *antennae* partly buff, partly brown or mouse-grey, second joint brown or dark brown, third joint mouse-grey or greyish-brown, more or less buff at base, longer and narrower than in *G. fusca* (cp. Figs. 18 and 16), distal extremity prominent,

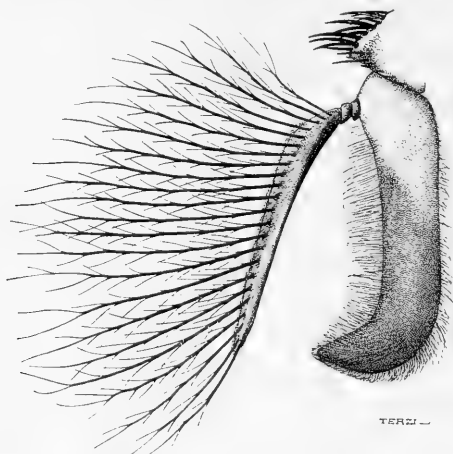


FIG. 18.

Antenna of *Glossina nigrofusca*, Newst. ($\times 30$.)

sometimes very prominent, arista buff, terminal joint as usual dark brown at base beneath, ridge on upper side of proximal portion of terminal joint very prominent, branched hairs more numerous and closer together than in *G. fusca*, varying in number from twenty-two to twenty-eight or twenty-nine; *palpi* slender, lighter or darker mouse-grey on outer side above, dark brown at tips, buff or greyish below on proximal three-fourths; *proboscis bulb* as in *G. fusca*.

Thorax.—Dorsum mouse-grey or drab-grey, with dark (olive-brown or dark brown) markings of the usual type; the latter, though usually not clearly defined, are often so extensive that little of the grey interspaces is visible; pleurae and pectus

smoke-grey pollinose, sternopleurae, as in *G. fusca*, with a dark blotch on each side of median ventral line; scutellum as in *G. fusca*, but *apical scutellar bristles* of ♀ (so far at least as may be judged from a single specimen *) *shorter*, little more than half so long as those of ♂.

Abdomen.—Dorsum clove-brown or dark brown, first segment, second segment except hind border and an ill-defined area on each side, and often also an ill-defined median area on third and fourth segments (not reaching hind borders), cinnamon; posterior angles and extreme lateral edges of third to sixth segments inclusive smoke-grey or drab-grey pollinose; seventh segment brownish-grey or mouse-grey pollinose, lighter grey on sides; hypopygium of ♂ isabella-coloured or greyish fawn-coloured.

Legs buff or ochraceous-buff, upper portion of femora on inner and outer sides, except at base and also at distal extremity in case of hind pair, more or less greyish-brown or mouse-grey; dark brown elongate blotch on under side of middle and hind femora near distal extremity often strongly marked; middle and hind tibiae with a more or less conspicuous (sometimes very conspicuous) dark brown ring round middle, front tibiae also often with a more or less distinct trace of a corresponding mark, tips of hind tibiae with a faint brown blotch on outer side; tips of last two joints of middle tarsi and tip of penultimate joint of front tarsi dark brown, tip of last joint of front tarsi brown (less dark than tip of preceding joint), last two joints of hind tarsi entirely clove-brown, upper side of remaining joints of hind tarsi mummy-brown or paler (cinnamon), third joint of hind tarsi sometimes dark brown at tip; short, felt-like hair on inner side of tips of hind tibiae and under side of first three joints of hind tarsi as in *G. fusca*.

Wings, squamae, and halteres as in *G. fusca*.

The above re-description has been drawn up from a ♂ and ♀ from Ashanti (*Dr. W. M. Graham*), in the Museum collection.

DISTRIBUTION OF *G. nigrofusca*, Newst.

The few specimens of this species received or recorded up to the present time show that the range of *G. nigrofusca* extends at any rate from Ashanti (where, according to *Dr. Graham*, it appears to be of local rather than general occurrence) to the

* One of the two females available for examination has lost its apical scutellar bristles.

Congo Free State. The data with regard to the four examples in the possession of the British Museum (Natural History) are as follows:—

Gold Coast Protectorate: 1 ♀, Dunkwa, Ashanti, 23. v. 1907, "caught at 2.30 p.m. on collector's leg," and 1 ♂, Obuasi, Ashanti, 31. vii. 1907, "in bush path" (*Dr. W. M. Graham, W.A.M.S.*). Southern Nigeria: 1 ♂, Oni River, 70 miles east of Lagos, 16. v. 1910, "caught in house, biting leg of European seated at table," and 1 ♀, same locality, i. xii. 1910, "caught in house" (*Dr. W. A. Lamborn*: presented by the Entomological Research Committee). Newstead records* 2 ♂♂ and 1 ♀, taken in Ashanti, at Sunyani, Odumase, and Atroni, on March 5, April 27, and August 16, 1910, respectively (*Dr. A. Kinghorn*), and 1 ♂, caught at Kasongo, Congo Free State, on February 6, 1904 (*the late Dr. J. E. Dutton and Dr. J. L. Todd*).

BIONOMICS.

All that can as yet be said under this heading may be gathered from the brief notes printed in the previous paragraph, which show that *G. nigrofusca* sometimes enters houses and will even attack the inmates, and that it appears to settle by preference on the legs.

SYNONYMY, AFFINITIES, AND DISTINCTIVE CHARACTERS.

The present species was actually described by Newstead under the name *Glossina grossa*, Bigot, which, as will be seen below,† now proves to be a synonym of *G. tabaniformis*, Westw. The alternative name *nigrofusca*, suggested by Newstead for what he called *G. grossa* in the event of his species being found to be distinct from Bigot's, must therefore be adopted.

As stated above,‡ in dealing with the affinities of *Glossina fusca*, Walk., *Glossina nigrofusca* belongs to the *G. fusca* group, from the three other members of which at present known it may be distinguished by the length of the fine hair on the third joint of the antennae (compare Figs. 18, 19 and 16). Although the females of *G. nigrofusca* and *fusca* closely resemble each other in general appearance, the former is on the whole a larger and bulkier insect; the head in both sexes is distinctly wider in *G. nigrofusca* than in *G. fusca*, and the second abdominal

* *Loc. cit.*, p. 374.

† *Cf.* p. 81.

‡ P. 74.

segment in the male is also broader in the former than in the latter. In size and general appearance there is a close resemblance between *G. nigrofusca* and *G. tabaniformis*, Westw.,* but the former may be distinguished by the greater length of the palpi, as well as of the hair on the anterior and posterior edges of the third antennal joint.

Glossina tabaniformis, Westw.

(Fig. 19.)

Glossina tabaniformis, Westwood, Proc. Zool. Soc. Lond., Part XVIII, p. 268, Plate XIX, fig. 3 (1850):—*nec* Stuhlmann, Bericht über Land- und Forstwirtschaft in Deutsch-Ostafrika, Bd. i, Heft 2, p. 173 (1902).

Glossina grossa, Bigot, Ann. Soc. Ent. Fr., Vol. LX, p. 377 (1891).

♂ ♀.—Length, ♂ (1 specimen) 10·4 mm., ♀ (4 specimens) 10·25 to 10·8 mm.; width of head, ♂ 3·25 mm., ♀ 3·4 to 3·5 mm.; width of front at vertex, ♂ 0·6 mm., ♀ 0·6 to just under 1 mm.; length of portion of palpi projecting beyond margin of buccal cavity, ♂ 3 mm., ♀ 3 to 3·25 mm.; † length of wing, ♂ 10 mm., ♀ 11·75 to 12·25 mm.

Large, dark brown, dusky-winged species, closely resembling G. nigrofusca, Newst., in general appearance, but distinguished by the palpi (and proboscis) being much shorter, and by the length of the fringe of fine hair on the anterior edge of the third joint of the antennae not exceeding one-third (instead of being equal to from one-half to three-fourths) of the width of the third joint (cf. Figs. 19 and 18).

Head cream-buff, antennal cavity pearl-grey, posterior surface of head mouse-grey; *frontal stripe* mummy-brown, paler anteriorly; *ocellar spot* inconspicuous, of same colour as frontal stripe, transverse band joining bases of vertical bristles dark brown; *antennae* partly buff, partly dark brown or brownish, second joint mainly dark brown or more or less brownish, third joint dark brown (a larger or smaller area at base buff or cream-buff), often

* See below.

† In the case of the type of *G. grossa*, Big. (a ♀), which, through the kindness of Mr. G. H. Verrall, is now in the British Museum (Natural History), the portion of the palpi projecting beyond the margin of the buccal cavity is somewhat longer, and measures 3·5 mm.

broader and in ♀ at any rate usually shorter than in *G. nigrofusca*, Newst. (cf. Figs. 19 and 18), distal extremity prominent, fringe of hair on front margin in length equal to from one-fourth to one-third of width of third joint, fringe of minute hairs on hind margin also much or distinctly shorter than corresponding fringe in case of *G. nigrofusca*, arista buff, first and second joints and third joint at base dark brown beneath, branched hairs from eighteen to twenty-three in number; *palpi* dark mouse-grey on outer side above, dark brown at tips, proximal three-fourths buff below; the *palpi* usually appear *less slender*—i.e. broader (viewed

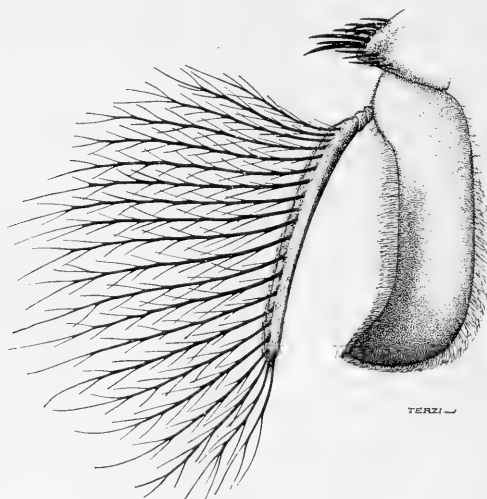


Fig. 19.
Antenna of *Glossina tabaniformis*, Westw. (× 30.)

from above) and deeper (viewed from the side)—than those of *G. nigrofusca*; proboscis bulb as in latter species.

Thorax.—General coloration as in *G. nigrofusca*, usual dark markings of dorsum more or less distinct; apical scutellar bristles of ♀ not short (about four-fifths so long as those of ♂).

Abdomen as in *G. nigrofusca*.

Legs buff, femora less infuscated than those of *G. nigrofusca*; middle femora sometimes with a dark greyish-brown elongate blotch on outer side beyond middle, hind femora occasionally with a faint indication of a similar infuscation; middle and hind tibiae with a vestige of a more or less incomplete dark brown ring round middle, which, however, may be very faint or entirely

wanting, hind tibiae with no trace of a brown blotch on outer side at distal extremity; tarsi as in *G. nigrofusca*, though upper side of first three joints of hind tarsi is sometimes scarcely darker than the hind tibia.

Wings, squamae, and halteres as in *G. nigrofusca*.

Although, through the kindness of Professor E. B. Poulton, F.R.S., I have been enabled to re-examine the type of this species (a ♀ from the Gold Coast, in the Oxford Museum*), since the insect is somewhat faded, the above re-description has been drawn up from a ♂ and ♀ taken at Oban, Southern Nigeria, in August, 1910, by Mr. J. H. J. Farquhar, and presented to the British Museum (Natural History) by the Entomological Research Committee.

DISTRIBUTION OF *G. tabaniformis*, Westw.

All that can at present be said under this heading is that the area of distribution of *G. tabaniformis* includes the Ivory and Gold Coasts, Southern Nigeria, and the Congo Free State. The following are the data with reference to the specimens examined, in addition to those already mentioned:—French Ivory Coast: 1 ♀ (the type of *G. grossa*, Bigot), Assinie (*Ch. Alluaud*: presented by Mr. G. H. Verrall). Southern Nigeria: 1 ♀, Ikom, Cross River, Eastern Province, 6. vi. 1910 (*Dr. W. S. Clark*: the property of the Entomological Research Committee). Congo Free State: 1 ♀, Leopoldville, 26. xii. 1903 (*the late Dr. J. E. Dutton, and Drs. J. L. Todd and C. Christy*).

BIONOMICS.

It would seem probable that the observations by Dr. C. Christy, published by the present writer in the *British Medical Journal* of September 17, 1904, as referring to *G. fusca*, actually related to *G. tabaniformis*. If this be so, Dr. Christy's statements show that in the Congo Free State *G. tabaniformis* may be found round houses and on board river steamers, and that it bites by night—at any rate, until about 11.0 p.m.

* Cf. Austen, "A Monograph of the Tsetse-Flies," p. 98 (1903).

AFFINITIES AND DISTINCTIVE CHARACTERS.

So far, at least, as regards external characters, *Glossina tabaniformis* may be distinguished from *G. nigrofusca*, Newst. (p. 77), *G. fusca*, Walk. (p. 69), and *G. fuscipleuris*, Austen (p. 75) —the three other species of the *Glossina fusca* group at present known, by the comparative shortness of its palpi; the length of the fringe of hair on the front border of the third joint of the antennae will also serve to distinguish *G. tabaniformis* from *G. nigrofusca* on the one hand, and from *G. fusca* and *fuscipleuris* on the other. The general resemblance of both *G. nigrofusca* and *fusca* to *G. tabaniformis* is certainly very strong, and it is possible that either the first or last mentioned species may ultimately prove to be a form of *G. fusca*, Walk.; in order to decide this question, however, a comparison of the male genital appendages is essential, and for this purpose the material at present available is insufficient in the case of *G. tabaniformis*.

CHAPTER VII.

THE GLOSSINA BREVIPALPIS GROUP.

SYNOPSIS OF SPECIES.

1. Dorsum of thorax with four sharply defined, dark brown, more or less oval or elongate spots, arranged in a parallelogram, two in front of and two behind the transverse suture; proboscis bulb with a sharply defined brown or dark brown tip *longipennis*, Corti.
Dorsum of thorax without such spots; proboscis bulb not brown or dark brown at the tip 2
2. Wings with upper, thickened portion of anterior transverse vein much darker in colour than adjacent veins, and thus standing out conspicuously against the rest of the wing *brevipalpis*, Newst.
Wings with upper, thickened portion of anterior transverse vein not much darker in colour than adjacent veins, and thus not standing out conspicuously against the rest of the wing (wings practically unicolorous)..... *medicorum*, sp. nov.

Glossina brevipalpis, Newst.

(Plate IX.)

Glossina brevipalpis, Newstead, *Annals of Tropical Medicine and Parasitology*, Series T. M., Vol. IV, No. 3, p. 372 (December 20, 1910).

Glossina fusca, Austen (*nec* Walker); Austen, *Monograph of the Tsetse-Flies*, pp. 95-97, Plate VI (1903); Sander, *Die Tsetsen*, pp. 66-68 (1905); Koch, *Deutsche Medizinische Wochenschrift*, Bd. xxxi (November 23, 1905),—translated by P. Falcke in *Journal of Tropical Medicine*, Vol. IX, pp. 137-138 (1906); Stuhlmann, *Arbeiten aus dem Kaiserlichen Gesundheitsamte*, Bd. xxvi, Heft 3, p. 301 *et seq.* (1907); Davey, *Bulletin of Entomological Research*, Vol. I, Part 2, pp. 143-145 (July, 1910); Pask, *ibid.*, pp. 145-146; Sanderson, *Bulletin of Entomological Research*, Vol. I, Part 3, pp. 225-226 (October, 1910), and Vol. I, Part 4, pp. 299-302 (January, 1911); S. A. Neave, *ibid.*, pp. 306-310.

Glossina tabaniformis, Stuhlmann (*nec* Westwood), *Bericht über Land- und Forstwirtschaft in Deutsch-Ostafrika*, Bd. i, Heft 2, p. 173 (1902).

♂, ♀.—Length, ♂ (317 specimens) 10·2 to 12·25 mm., ♀ (42 specimens) 11 to 13·5 mm.; width of head, ♂ 3·25 to

86 DESCRIPTION OF GLOSSINA BREVIPALPIS.

3.6 mm., ♀ 3.25 to 3.75 mm.; width of front at vertex, ♂ 0.5 to 0.6 mm., ♀ just under 1 mm. to 1 mm.; length of portion of palpi projecting beyond margin of buccal cavity, ♂ 2.25 to

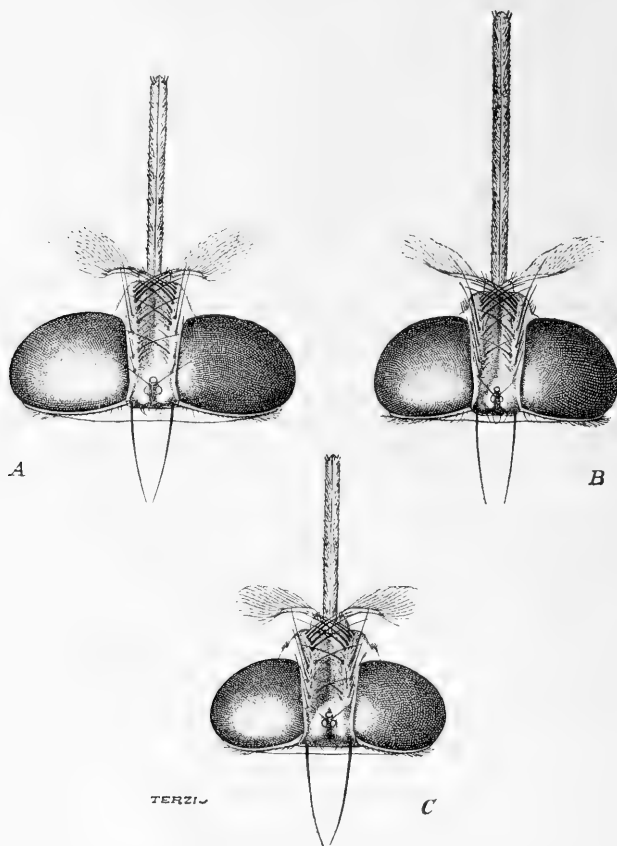


Fig. 20.

Heads of males of (A) *Glossina brevipalpis*, Newst., (B) *G. fusca*, Walk., and (C) *G. medicorum*, sp. nov. (see p. 98), dorsal aspect; showing differences in the size and shape of the head as a whole, in the shape of the eyes, and in the length of the palpi. ($\times 10$.)

3 mm., ♀ 3 to 3.25 mm.; length of wing, ♂ 10.2 to 12 mm., ♀ 11.5 to 14 mm.

Large species, somewhat resembling G. longipennis, Corti, but distinguished inter alia by the front being narrower, and by the absence of a dark brown ocellar spot, of a brown tip to the proboscis

bulb, and of the characteristic dark brown spots on the dorsum of the thorax; distinguished from *G. fusca*, Walk., inter alia by the proboscis and palpi being much shorter, the head (especially in the ♂) distinctly wider and in both sexes closer to the thorax, the front

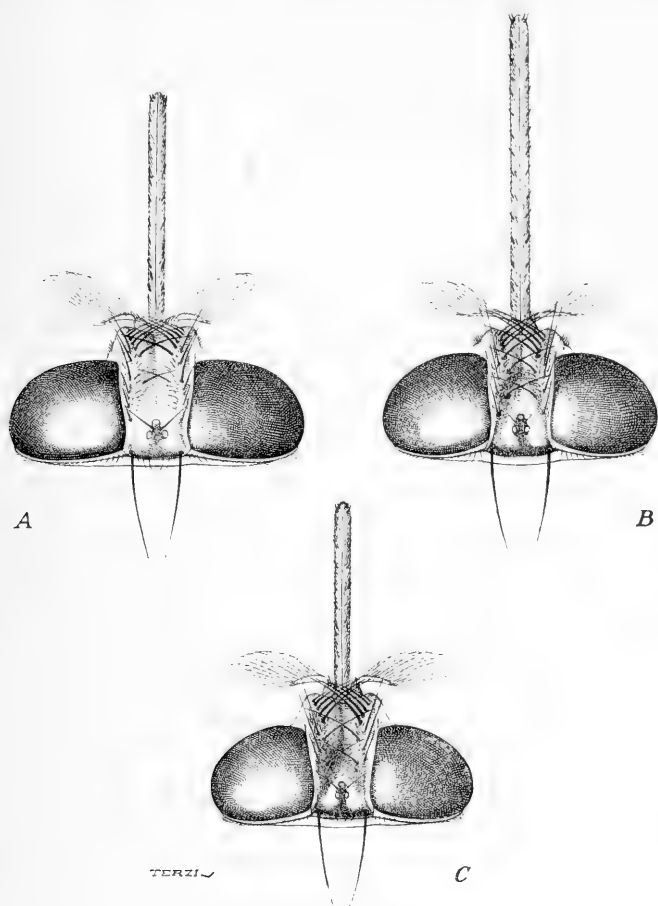


Fig. 21.

Heads of females of (A) *Glossina brevipalpis*, Newst., (B) *G. fusca*, Walk., and (C) *G. medicorum*, sp. nov. (see p. 98), dorsal aspect; showing differences in the size and shape of the head as a whole, in the shape of the eyes, and in the length of the palpi. ($\times 10$.)

in the ♂ relatively narrower, the frontal stripe and general coloration of the dorsum of the thorax and of the wings paler, the usual longitudinal markings on the dorsum of the thorax generally

less strongly developed, the size being often larger, and the general appearance usually bulkier.

**Head* cream-buff, posterior surface greyish; *frontal stripe* buff, or light raw-sienna coloured; *ocellar spot* light brownish, inconspicuous, ocelli relatively large; *face* (including facial pit), frontal margins narrowly, and posterior orbits below shimmering whitish-yellow pollinose; bases of vertical bristles connected by a more or less distinct brown or brownish band; *eyes* with their transverse diameters longer than in *G. fusca*, so that, when the head is viewed from above, its lateral portions appear somewhat flattened in an antero-posterior direction; *antennae* buff or cream-buff, second joint brown on inside, third joint brown or dark brown except extreme base or proximal third, anterior distal extremity of third joint often prominent, *arista* buff, terminal joint fairly stout, dark brown at base beneath, branched hairs eighteen to twenty-two in number; *palpi* buff, lighter in colour as well as shorter than in *G. fusca* and also stouter, mouse-grey on upper portion of outer surface and darker at tips; *proboscis bulb* pale yellow, often with a brown spot on its upper margin on each side.

Thorax light mouse-grey or isabella-coloured, dorsum in rubbed specimens sometimes tinged with fawn colour, series of markings on dorsum, as described for *G. palpalis*, much reduced and often very inconspicuous, mouse-grey or light brown; most distinct are the two narrow admedian stripes, the narrow curved stripe outside these on each side, two faint blotches enclosed by each curved stripe, one in front of and one behind the transverse suture, and the spot on the suture, between the admedian and the curved stripe on each side; spot on inner margin of humeral callus usually very faint; dark blotches on pectus (sternopleurae), which are often conspicuous in *G. fusca*, scarcely visible, or brownish in colour and faintly indicated; scutellum greyish-brown, margin and impressed median line buff or cream-buff, apical scutellar bristles in ♀ of medium length.

Abdomen.—Dorsum dark brown, first segment, and also second segment to a greater or less extent, paler, ochraceous-buff or cinnamon-coloured, extreme hind margins of second to sixth segments inclusive usually pale (cream-buff), posterior angles of these segments drab-grey or smoke-grey, dark brown area occupying third to sixth segments inclusive, sometimes distinctly broken up into a series of interrupted transverse bands; seventh

segment in both sexes yellowish-grey or fawn-coloured pollinose; *hypopygium* of ♂ (Fig. 24 A, p. 99) buff pollinose, seen from below roughly oval in outline, with its anterior margin flattened; longer hair at base of second segment golden-yellow in middle, dark brown or black at sides; third, fourth and fifth segments very short (shorter than corresponding segments in *G. fusca*).

Legs buff, middle and hind tibiae as a rule with (at any rate an indication of) a brown ring round middle, most conspicuous, darkest, and often complete on hind tibiae, fainter, generally incomplete, and often reduced to a mere trace on middle tibiae, front tibiae usually with a vestige of a corresponding ring, generally reduced to a faint brownish blotch on inside in middle; front femora on inside (sometimes also on outside), middle and hind femora on outside towards distal extremity usually slightly infuscated, middle femora generally with a brownish blotch on under side near tip; front and hind tibiae towards the tips and first three joints of front and hind tarsi clothed beneath with short golden pile; last two joints of front tarsi more or less infuscated at the tips; last two joints of middle and hind tarsi, except proximal half of penultimate joint of middle tarsi, dark brown; extreme tips of other tarsal joints sometimes infuscated.

Wings pale isabella-coloured, distal extremity somewhat darker than proximal third; veins pale tawny, upper portion of anterior transverse vein strongly incrassate, anterior transverse vein together with adjacent portion of fourth longitudinal vein lying towards base of wing, as well as posterior transverse vein and portion of fourth vein immediately beyond, conspicuously infuscated; basal portion of the veins from the second to the sixth also darker. *Squamae* not infuscated, fringe of pale brownish or yellowish, fine, silky hair rather long. *Halteres* cream-buff.

The specimens from which the above description has been drawn up are a ♂ and ♀ from the Nyasaland Protectorate (*Dr. J. B. Davey*: presented by the Entomological Research Committee (Tropical Africa)), in the British Museum Collection—the ♂ from North Nyasa, taken in the evening on the Karonga-Songwe road, two miles south of Kaporo, 5. viii. 1909, the ♀ caught at Nkomo, Marimba district, 23. i. 1910.

DISTRIBUTION OF *G. brevipalpis*, Newst.

Glossina brevipalpis, to which the name *G. fusca* has hitherto been applied in error, is the common large Tsetse-fly in many parts of South-Central and East Africa, but, although found in the Congo Free State, it does not, so far as our present knowledge goes, occur in West Africa proper. Reliable records and the data attached to the specimens available for examination show that *G. brevipalpis* exists in Portuguese East Africa, the Nyasaland Protectorate (where it has a wide distribution, being abundant at certain seasons in and near the Songwe Valley, at the north end of Lake Nyasa, besides occurring in and on the edge of the Elephant Marsh, near the Lower Shire River, to the south of the lake *), North-Eastern Rhodesia,† German East Africa (where it is found in large numbers in the vicinity of Amani—at the foot of the Usambara Mountains—and also elsewhere ‡), the (British) East Africa Protectorate, the Katanga district of the Congo Free State, and in Angola.

It has not been thought necessary to give precise details concerning the localities and dates of capture of the whole of the 359 specimens examined, the majority of which were collected in the Nyasaland Protectorate by Drs. Sanderson and Davey, to whose papers (quoted above) reference should be made for further information. The data as to the specimens received from countries other than Nyasaland are as follows :—

Portuguese East Africa : 2 ♂ ♂, 1 ♀, Bamboo Creek, Beira Railway, 1908 (received from Ll. E. W. Bevan, M.R.C.V.S.). North-Eastern Rhodesia : 1 ♂, Kanga Stream, eight miles east of Hargreaves, Luangwa Valley, "just after sunset," 16. ix. 1910, and 1 ♀, within a few hundred yards of Molilo's, fourteen miles east of Hargreaves, "about 10 a.m." 17. ix. 1910 (*S. A. Neave* : presented by the Entomological Research Committee). German East Africa : 1 ♀, Kilima Njaro, 1888 (*F. J. Jackson, C.B., C.M.G.*); 11 ♂ ♂, 7 ♀ ♀ (all bred in captivity), 2 dried larvae and 11 pupae and puparia, Amani, January, 1907

* *Cf. Sanderson, loc. cit.*, p. 299, and *Davey, loc. cit.*, p. 143.

† For notes on the occurrence of *G. brevipalpis* in N.-E. Rhodesia, where it has hitherto been met with only in the Luangwa Valley, in the vicinity of Hargreaves (Chutika's), and in very small numbers, see *S. A. Neave, Bulletin of Entomological Research, Vol. I, Part 4, pp. 306-310 (January, 1911).*

‡ *Cf. Stuhlmann, Arb. a. d. Kais. Gesundheitsamte, Bd. xxvi, Heft 3, pp. 301-302 (1907).*

(*Dr. F. Vosseler*). East Africa Protectorate: 1 ♀, Upper Sabaki River, 1890 (presented by the late British East Africa Company); 1 ♀, Uganda Railway (? Kiboko River or Sabaki River, near its junction with the Tsavo River), 1898 (*the late Vet.-Capt. A. J. Haslam*); 1 ♂, 2 ♀ ♀, Witu Forest, 1895 (*the Sultan of Witu*—presented by the late W. S. Godfrey); 2 ♀ ♀, Kibwezi, 1903, "in railway carriage" (*Dr. R. U. Moffat, C.M.G.*—per Colonel Sir David Bruce, C.B., F.R.S., A.M.S.); 10 ♂ ♂, 10 ♀ ♀, Kibwezi, 1903 (received from the Sleeping Sickness Commission, per Dr. D. Nabarro); 1 ♀, Mwatate district, near Voi, January, 1909 (received from R. J. Sturdy). Congo Free State (Katanga district): 4 ♂ ♂, near Charowi, 21. vi. 1907, and 12 ♂ ♂, 3 ♀ ♀, Kiubo Falls, Lufira River (Lat. 9° 30' S., Long. 27° E.), 23. vi. 1907 (*S. Neave, M.R.C.P., M.R.C.S.*); 1 ♂, 1 ♀, Kiubo Falls, 2. viii. 1909 (*Dr. F. O. Stoehr*). Angola: 1 ♀, Canhoca, 17. viii. 1910 (*Dr. W. J. Ansorge*).

BIONOMICS.

In view of the possibility that *G. brevipalpis* may ere long be proved to be a carrier of human trypanosomiasis, and the fact that in the German East African littoral, at any rate, it is stated to be the chief disseminator of Tsetse-fly disease among domestic animals,* special importance attaches to a knowledge of the bionomics of the present species. Although many important details have doubtless still to be recorded, thanks to the observations and writings of Drs. Franz Stuhlmann, J. B. Davey, and Meredith Sanderson,† more is already known concerning the habits of *G. brevipalpis* than about those of any other Tsetse, with the exception of *G. palpalis* and *morsitans*. Stuhlmann (who, like the other authors, of course writes of the species as *Glossina "fusca"*), besides furnishing a detailed description of the anatomy and histology of the internal organs,‡ has also provided us with an interesting account of *G. brevipalpis* as observed by him in German East Africa, both under natural conditions and in captivity, and the following résumé is based upon his statements and those of the English writers mentioned above, whose observations were made in the Nyasaland Protectorate.

* Stuhlmann, *loc. cit.*, p. 302.

† Cf. references on p. 85.

‡ *Loc. cit.*

Glossina brevipalpis, which is often met with in very large numbers, is found, at altitudes varying from sea-level to some 1,700 feet, as a rule only where there is abundant shade and protection from wind, its favourite haunts consisting of bush mixed with creepers and young forest trees, either close to watercourses (dry or otherwise), or at any rate within a few hundred yards of water. Stuhlmann has encountered the fly close to the sea, near Dar es Salam, and Davey records the occurrence of a single specimen amongst "bango" reeds a few yards from the edge of Lake Nyasa. Sanderson has been informed by natives that during the rains (*i.e.* about January), "at which time practically the whole country is under water," the species is very prevalent in North Nyasa all over the grassy plain lying between the shore of the lake and a line of foot-hills some ten miles away, but this statement requires confirmation. Like *G. palpalis* and other species of Tsetse, *G. brevipalpis* will occasionally follow cattle and other animals to some distance from its usual haunts; Stuhlmann states that in this way, especially during the hot weather, isolated specimens were frequently found for a time among the mountains of East Usambara, at an altitude of from 800 to 1,000 metres (2,600 to 3,250 feet), while, during the period from December to April, others have often been met with in settlements such as Kwamkoro and Amani. Davey records the capture of a single individual "on the finger of a native standing under a tree in the middle of a small village," and in another village Sanderson once caught two specimens in a hut occupied by natives, and also containing a cow infected with trypanosomiasis.

The present species of Tsetse is active and desirous of feeding only at two periods of the day—early in the morning before 8.0 o'clock, and in the evening, from about 4.0 P.M. onwards. The intervening hours, from 8.0 A.M. to 4.0 P.M., are passed by *G. brevipalpis* in concealment, "under leaves of bushes or in the grass, always near the ground" (Sanderson), or low down on the trunks of trees, two or three feet from the base. While thus resting motionless the flies are difficult to discover and capture, and "their presence would be entirely unsuspected" (Sanderson); at Kaporo, near the north end of Lake Nyasa, Davey found that they preferred to rest on "trees surrounded by creepers and undergrowth, and hid away in crevices in the bark or under the origin of branches." Both Davey and Sanderson observed a pair *in coitû* on a tree-trunk, in the one case at midday, in the other

at about 5.0 P.M.; attempts to find the pupae of this fly by digging round the bases of various trees were however unsuccessful. Davey states that about 4.0 P.M. *G. brevipalpis* "seems to emerge from its hiding place and settle on dried leaves, sticks or dust on paths, apparently lying in wait for a meal"; the same writer adds that he has noticed that "game, on its way to water in the evening, often stands for a time on emerging from the

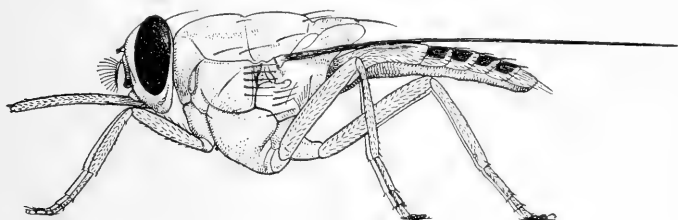


Fig. 22.

A Tsetse-fly (*Glossina morsitans*, Westw., ♀), before feeding. (× 6.)

forest on to a path, and would thus afford the fly an opportunity for feeding." According to Davey, *G. brevipalpis* as a rule "seems ready to bite human beings in the evening, but it does not set to work with the rapidity and voracity that *G. morsitans* often exhibits." When feeding captive flies, Stuhlmann finds

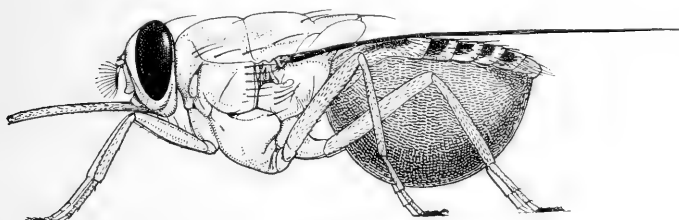


Fig. 23.

A Tsetse-fly (*Glossina morsitans*, Westw., ♀), after feeding, showing abdomen distended with blood. (× 6.) From a drawing from life, kindly lent by Colonel Sir David Bruce, C.B., F.R.S., A.M.S.

that the insects generally wait for a while before deciding to suck; they then, however, drive in the proboscis with great quickness, and the abdomen usually becomes swollen out like a balloon with blood in from thirty to forty seconds. In captivity flies of this species show very little inclination to feed in very hot and sultry weather, and this is also the case when the

temperature is abnormally low.* Although continuing to bite and fly about "for some time after dark" (Sanderson), *G. brevipalpis* appears not to bite during the actual night hours, and specimens kept in captivity in glass cylinders were found in complete darkness to be perfectly still (Stuhlmann). Like *G. palpalis* and blood-sucking flies in general, the present species displays a predilection for dark-coloured animals and surfaces. Stuhlmann states that he has frequently noticed that, when a light- and a dark-coloured mule were moving side by side, only the latter was attacked, and Sanderson writes:—"The flies bite through dark clothes, but have never been seen to settle on white surfaces."

As to the relation of *G. brevipalpis* to game, Davey observes that wherever he met with this fly in Nyasaland "game (antelope, warthog, etc.) was abundant." Once during the wet season, having shot two bush-pigs about sunset, on going up to the animals he found several *G. brevipalpis* settling upon the carcasses and "apparently trying to suck blood" from them, although for some time previously he had searched for the flies without success.

It will have been noticed that, out of the 359 specimens of this species examined by the present writer, only 42 were females, and the enormous preponderance of males over females usually seen among *captured* specimens has been noted both by Stuhlmann and Davey.† It is pointed out, however, by the former author that, as in the case of other flies, it is shown by breeding *G. brevipalpis* in captivity that the two sexes are produced in approximately equal numbers. In order to catch females, Stuhlmann states that it is necessary to use animals such as cattle and mules as decoys, but even so he observes that they are much more difficult to capture than males. He thinks it probable that "the gravid females are much more wary and move about less than the males, and are consequently more rarely caught."

* In order to keep captive flies alive, a meal of blood at intervals of from four to six days is necessary; by feeding every fourth or fifth day, Stuhlmann has kept *G. brevipalpis* at Amani for considerable periods—in the case of individual females, for upwards of four months.

† In German East Africa, fly-boys sent out by Stuhlmann into the Mkulumusi Valley below Amani, brought back in one week over 1,200 *G. brevipalpis*, of which only 90 were females. At Kaporo, near the north end of Lake Nyasa, out of 117 *G. brevipalpis* caught in the evenings in August (dry season), all were males (Davey). On the other hand: "Seven were captured at the same place and time of year about midday, and of these, four were males and three were females."

REPRODUCTION AND PRELIMINARY STAGES.

According to Stuhlmann's observations on female specimens of *G. brevipalpis*, kept by him in captivity at Amani, German East Africa, the act of birth, though occasionally lasting for a quarter of an hour or more, generally takes place very quickly. The larvae produced by a female kept at a temperature of from 23° to 25° C. (73·4° to 77° F.) were extruded at intervals, which varied with the temperature from ten to twenty-two days, the mean interval being about twelve days; thus in three months and a half a single female gave birth to eight larvae, two of which however were not viable. Throughout the period during which females of *G. brevipalpis* were kept at Amani (*i.e.* from the beginning of September, 1905, until the middle of May, 1906), the extrusion of larvae proceeded uninterruptedly at approximately regular intervals, though these were somewhat shorter in the hot than in the cold weather. Stuhlmann consequently sees no reason why in nature the production of larvae should not continue throughout the year, though he suggests that the height of both the wet and dry seasons may be unfavourable to the development of the pupae.

The newly extruded larva, which is of the usual *Glossina* type and shape, and, as stated by Stuhlmann, measures from 9 to 10 mm. in length by 2 to 3 mm. in width, is, with the exception of the hindmost segment, pale yellowish-white in colour, with the surface of the integument of the first eleven segments of the usual finely granular and shagreen-like texture; the last or twelfth segment, which bears the tumid lips or anal protuberances, is, as in other *Glossina* larvae, deep black. The anterior portion of this segment is encircled by a band of longitudinal ridges, and the outer surface of each lip or protuberance is, as usual, granular (though the granulations are not nearly so coarse or sharply defined as in the case of *G. palpalis*), and bears two more or less clearly marked grooves or furrows, which thus divide it into three prominences. The lips are actually smaller than in *G. palpalis* and different in shape (not so full and rounded). A dried larva of *G. brevipalpis* from Amani (*Dr. F. Vosseler*), measuring 9·5 mm. in length, by 4·25 mm. in greatest width, shows that the inner surfaces of the tumid lips, instead of being close together and separated by a deep and narrow notch, as in *G. palpalis*, are divided by a relatively wide and shallow space, something like a wide V.

"If," writes Stuhlmann, "the new-born larva be placed in a glass dish or on blotting-paper, it crawls about for a time exactly like an ordinary fly-maggot, after which it becomes stationary and soon contracts, its chitinous integument thickens and darkens, and in about three-quarters of an hour it has assumed the appearance of a 'coarctate' pupa. If, however, the larva be transferred to moderately damp sand, it at once burrows into it, making a straight tunnel; thus in one case a larva penetrated to a depth of 8.5 cm. ($3\frac{1}{3}$ inches). Under such conditions, from an hour and a quarter to an hour and a half elapsed before the change to the pupal stage was completed. In dry sand a larva did not burrow so deeply, since, as it burrowed, the sand continually fell in, but nevertheless it reached a depth of from 2 to 3 cm. ($\frac{3}{4}$ to $1\frac{1}{8}$ inch). We may assume that in nature the larvae behave in a similar way; the fly will deposit its offspring on a spot which is sheltered and slightly damp, and the larva will at once burrow beneath the surface."

The pupa (Figs. 5 A, 6 A, pp. 5, 7), which is of the usual black or clove-brown colour, measures about 7.5 to 8 mm. in length, by 4 to 4.5 mm. in greatest breadth; * the shape and dimensions of the tumid lips and the shape of the notch between them are of course the same as in the larva. At Amani, the duration of the pupal stage was found by Stuhlmann to be from thirty to sixty-five days, according to the temperature; when pupae were kept in the breeding-cage at 30° C. (86° F.) the flies emerged on the average in about thirty-six days. The pupal stage appeared to Stuhlmann to last somewhat longer in this species than in *G. tachinoides*.

Although a *Glossina* escapes from its pupa-case in precisely the same manner as any other Muscid fly, it may be of interest to quote Stuhlmann's account of the emergence of the imago of *G. brevipalpis*. "The fly," writes Stuhlmann, "bursts off the cap of the pupa-case, and protruding from the opening its cephalic vesicle,† forces its body-fluid into the latter, so that its body becomes sufficiently thin to be able to creep out of the puparium. Immediately after the insect has made its escape the cephalic vesicle is retracted into the interior of the head and never used again. In a short time the young fly draws air into

* So far as may be judged from an examination of seven specimens from Amani (*Dr. Vosseler*); since these are from larvae deposited in captivity, it is possible that in certain cases the dimensions are slightly subnormal.

† Termed by Dipterists the *ptilinum*.—E. E. A.

its tracheae, and, as a result of so doing, expands greatly; the wings, which until now have been folded, become spread out, and the abdomen swells to twice or thrice its original size. The proboscis, which in the pupa was directed backwards, is now stretched out in front, and the chitin everywhere hardens. After from three to five hours it would be impossible to tell from the appearance of the fly that it is still quite young, and, although on the first day reluctant to feed, it sucks blood greedily on the second."

It may be noted that there is some evidence that *parthenogenesis* may in exceptional circumstances occur in *Glossina*, since Stuhlmann states that at Amani on two occasions virgin females of *G. brevipalpis*, bred in captivity, produced fully developed larvae.

SYNONYMY AND AFFINITIES.

As will have been seen from the references to literature given above, the species of Tsetse described and figured by the author in his "Monograph" as *Glossina fusca** was in reality that recently characterised by Newstead under the name *Glossina brevipalpis*, and not the true *G. fusca*, Walk. This regrettable error has naturally had the effect of misleading subsequent writers, all of whom with the exception of Newstead, in so far as they have dealt with the Tsetse-flies of Nyasaland or East Africa, have referred to the present species as *Glossina fusca*. At the time when the Monograph was written the *Glossina*-material at the author's command was both scanty and for the most part in poor condition,† so that to form correct conclusions as to the characters of species was by no means easy; since then, however, the National Collection has had little reason to complain of lack of specimens, and it is now possible to revise the determinations of eight years ago with a fair degree of confidence. As a matter of fact, the author has for some time been convinced that under the designation *Glossina fusca* several species were confounded, and he had actually drawn up (under another name) the above description of *G. brevipalpis* in MS. before Mr. Newstead's paper appeared.

Together with *Glossina longipennis*, Corti, and *G. medicorum*, Austen (see below, pp. 102, 98), *G. brevipalpis* forms a well-defined group (which may be called the *Glossina brevipalpis* group) of

* Austen, "Monograph of the Tsetse-Flies," pp. 95-97, Plate VI (1903).

† Cf. Austen, *op. cit.*, "Introduction," p. vi.

generally large-sized species, the members of which may, as a rule, be distinguished from those belonging to the *Glossina fusca* group by their much shorter proboscis and palpi; the wings too are generally paler in the former than in the latter group. The most conspicuous differences exhibited by the present species as compared with *G. longipennis*, which it closely resembles in size, have already been given in the diagnosis which precedes the description printed above. The characters by which *G. medicorum* may be distinguished from *G. brevipalpis* are pointed out below in the diagnosis and description of the former, whose area of distribution, so far at any rate as at present known, is quite different from that of *G. brevipalpis*.

***Glossina medicorum*, sp. nov.**

(Figs. 20, C, and 21, C, pages 86, 87, and Fig. 24, B.)

♂, ♀.—Length, ♂ (3 specimens) 9 to 10 mm., ♀ (3 specimens) 10 to 10.6 mm.; width of head, ♂ 2.8 to 3 mm., ♀ 3.2 mm.; width of front at vertex, ♂ 0.5 to 0.75 mm., ♀ just under 1 mm.; length of portion of palpi projecting beyond margin of buccal cavity, ♂ 2.5 to 2.75, ♀ 2.8 to 3 mm.; length of wing, ♂ 9.75 to 10.25, ♀ 11.5 to 12 mm.

Medium sized, or in the ♀ sex (which, so far as may be judged from the three specimens of each sex available for examination, considerably exceeds the ♂ in size), fairly large species, allied and presenting a superficial resemblance to G. brevipalpis, Newst., but distinguished in both sexes by the wings having the appearance of being uniformly coloured (the upper portion of the anterior transverse vein, the posterior transverse vein, and the portions of the fourth longitudinal vein, that in G. brevipalpis are conspicuously infuscated, are not or scarcely at all infuscated in the present species), and in the ♂ by well-marked differences in the hypopygium and hectors (cf. B and A, Fig. 24, p. 99).

Head buff, posterior surface greyish; frontal stripe cinnamon or light mummy-brown; ocellar spot inconspicuous; face and lower half of posterior orbits shimmering whitish-yellow pollinose; bases of vertical bristles connected by a well marked dark brown band; antennae partly buff, partly brown or mouse-grey, outer surface of second and base of third joint buff, inner surface of

second joint dark brown, third joint (tip of which is moderately prominent) greyish brown or dark mouse-grey with a light grey pollinose shimmer, arista buff, terminal joint fairly stout, dark brown at base beneath, branched hairs seventeen to nineteen in number; *palpi* buff, mouse-grey on upper portion of outer surface, and darker or even dark brown at tips; *proboscis bulb* pale yellow.

Thorax.—Dorsum drab-grey, with the usual dark markings seal-brown or light seal-brown and fairly distinct; pleurae smoke-grey; pectus fawn-coloured, no dark blotches (or merely faint vestiges thereof, much reduced in size) on sternopleurae; upper

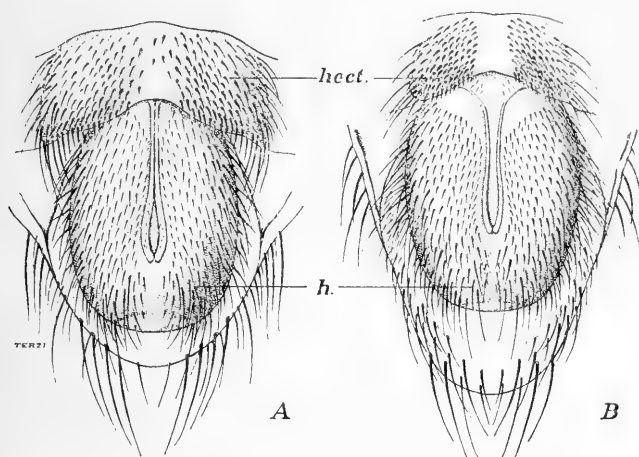


FIG. 24.

Distal extremity of ♂ abdomen of (A) *Glossina brevipalpis*, Newst., and (B) *G. medicorum*, sp. nov. (ventral aspect), showing (h) hypopygia and (hct.) hectors.* (× 15.)

surface of scutellum brownish, impressed median line and under surface buff, apical scutellar bristles of ♀ of medium length.

Abdomen.—Dorsum dark brown, not banded, first segment, median area of second segment, except hind border, and sometimes a similar area on following two or three segments buff or ochraceous-buff, seventh segment in both sexes yellowish-grey pollinose; *hypopygium* and *hectors** of ♂ as shown in Fig. 24 B; *hypopygium* buff pollinose, viewed from below broader (therefore relatively if not actually bulkier) than in *G. brevipalpis*, Newst.; *hectors* beset with relatively very coarse short bristles or minute spines, placed close together; the group of minute spines forming

* See p. 14 (first paragraph and note *).

each hector separated from those of the opposite group by a sharply defined interspace of perfectly bare integument, whereas in the case of *G. brevipalpis* the minute bristles forming the hectors are less coarse, less closely set, and generally intermingle, at least in front, so that the interspace is as a rule partly obliterated.

Legs buff or cream-buff; front femora usually more or less infuscated on inner side, middle and hind femora often with a small, elongate, dark brown or mummy-brown blotch on under side near distal extremity; hind tibiae usually with a more or less indistinct vestige of a dark brown ring round middle, a trace of a corresponding ring also sometimes visible on middle tibiae; tips of last two joints of front and middle tarsi, and last two joints of hind tarsi, except extreme base of penultimate joint, blackish-brown.

Wings pale isabella-coloured, practically unicolorous, distal portion not noticeably darker than proximal third, and upper, thickened portion of anterior transverse vein not (as in *G. brevipalpis*) much darker in colour than adjacent veins, and, therefore, not standing out conspicuously against the rest of the wing, as is the case in the species mentioned; veins tawny-ochraceous or cinnamon-coloured.

Squamae and fringe, and *halteres* as in *G. brevipalpis*.

The typical specimens are a ♂ and ♀ in the British Museum (Natural History), from the Sangwin River, Liberia, West Africa, 27. xi. 1908, taken and presented by Surgeon A. McCloy, R.N.

Pale form.—In addition to that described above as typical, there appears to occur a form of this species in which the coloration of the body is decidedly paler; the specimens from Odumase, Gold Coast, and Asaba, Southern Nigeria, mentioned below, belong to this form, which there is no reason to regard as anything more than a mere colour-variety.

DISTRIBUTION OF *G. medicorum*, sp. nov.

Up to the present time, this species of Tsetse has been found only in West Africa (Liberia, Gold Coast, and Southern Nigeria). In addition to the types of the ♂ and ♀, the following specimens, also contained in the National Collection, have been examined:—
1 ♂, same locality and date as types (*Surgeon A. McCloy, R.N.*);
1 ♀, Sekondi, Gold Coast, 28. vii. 1907, "caught in P. W. D.

bungalow at night" (Dr. W. M. Graham, W.A.M.S.); 1 ♂, Odumase, Gold Coast, March, 1908 (G. C. Dudgeon); 1 ♀, Asaba, Southern Nigeria, 1895 (the late Dr. W. H. Crosse).

BIONOMICS.

Nothing is yet known as to the habits of this species, although from the note quoted above, attached to the specimen taken by Dr. Graham at Sekondi, it would seem that it sometimes moves about after dark, at any rate when attracted by light.

AFFINITIES AND DISTINCTIVE CHARACTERS.

As stated above, in the section dealing with the affinities of the foregoing species, *Glossina medicorum* belongs to what may be termed the *G. brevipalpis* group, the third member of which is *G. longipennis*, Corti. Attention has already been drawn to the distinctive characters of *G. medicorum* as compared with *G. brevipalpis*, Newst., and the former may at once be distinguished from *G. longipennis*, Corti, by its smaller and narrower head, and by the absence of a dark brown ocellar spot, of a brown tip to the proboscis-bulb, and of the dark brown spots on the dorsum of the thorax characteristic of Corti's species.

From *Glossina fusca*, Walk., *G. medicorum* differs in both sexes (apart from the wings, which are usually paler) in the front, viewed vertically from above, being (at least relatively) wider, in the proboscis and palpi being shorter, and the latter (as seen from above) being broader and less slender, and in the absence of a conspicuous dark blotch on each sternopleura; as regards characters confined to one sex, the ♂ of *G. medicorum* is distinguished from that of *G. fusca* by the minute spines or bristles forming the hectors being coarser, while in the ♀ the apical scutellar bristles in the former species are stouter and shorter (about half the length of the corresponding bristles in *G. fusca* ♀). *G. medicorum* is distinguishable from *G. tabaniformis*, Westw., which occurs in the same region, *inter alia* by the third joint of the antenna not being clothed with long and fine pale hair, by the general coloration of the body being as a rule less dusky, by the wings being paler or at any rate not so brown, and by the anterior transverse vein being less coarse.

Glossina longipennis, Corti.

(Plate X.)

Glossina longipennis, Corti, Ann. Mus. Civ. Genov., Serie 2^a, Vol. XV (XXXV), p. 138 (1895); Hough, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 172; Austen, Proc. Zool. Soc. Lond., 1900, p. 10, and "A Monograph of the Tsetse-Flies," p. 101, Plate VII (1903); Brumpt, Comptes rendus des Séances de la Société de Biologie, T. lv, p. 1497 (1903), and T. lvi, p. 673 (1904).

♂, ♀.—Length ♂ (6 specimens) 10·2 to 11·6 mm., ♀ (3 specimens) 11·4 to 13 mm.; width of head, ♂ 3·4 to 3·6 mm., ♀ 3·5 to 3·75 mm.; width of front at vertex, ♂ just under 1 mm., ♀ 1·2 mm.; length of portion of palpi projecting beyond margin of buccal cavity, ♂ 2·4 to 2·8 mm., ♀ 3 mm.; length of wing, ♂ 10·8 to 11·25 mm., ♀ 12 mm.

Resembling G. brevipalpis, Newst. (p. 85, Plate IX), in size and general appearance, but distinguished by the greater width of the front in both sexes, by the ocellar spot being dark brown or clove-brown, and conspicuous, instead of merely light brownish and inconspicuous, by the proboscis bulb having a sharply defined brown or dark brown tip instead of being uniformly pale yellow (at any rate except on the upper margins), and by the dorsum of the thorax exhibiting, in addition to a pair of admedian spots on the suture itself, four sharply defined, dark brown, more or less oval or elongate spots, arranged in a parallelogram, two in front of and two behind the transverse suture.

Head buff, posterior surface smoke-grey, yellowish-grey, or drab-grey; *frontal stripe* scarcely deeper in colour than frontal margins (parafrontals), the latter, as well as the face and facial pit, faintly shimmering whitish-yellow pollinose; *ocellar spot* conspicuous owing to its colour, ocelli small, of equal size; vertical bristles with a mummy-brown or light brown spot at base of each, but not connected by a brown band; first and second joints of *antennae* cream-buff, second joint more or less brown on inside, third joint mouse-grey, brownish-grey, or isabella-coloured, front margin with a short fringe of fine and minute hairs (somewhat longer than corresponding fringe in case of *G. brevipalpis*, Newst.), distal extremity broad and prominent, especially in ♀, *arista* buff, terminal joint fairly stout and in ♀ somewhat short, dark brown at base beneath, branched hairs about twenty-one in number; *palpi* buff-yellow, not darker above,

tips dark brown; *proboscis* *bulb* buff-yellow, distal third dark brown or brown.

Thorax isabella-coloured pollinose, dorsum with a narrow, faint, mouse-grey or brownish, longitudinal stripe on each side of median line, dying away behind transverse suture before reaching hind margin; besides these stripes and the spots mentioned in the diagnosis printed in italics above, the principal noticeable markings on the dorsum are a more or less distinct brown or brownish fleck on each humeral callus, near its upper margin, and a similarly coloured, elongate mark between this and the admedian stripe; the two dark brown spots in front of the suture slightly further apart than the two behind it; the admedian spots on the suture itself paler in colour than the other four; scutellum cream-buff, upper surface with a mouse-grey or greyish-brown blotch, triangular in outline, on each side of middle line; apical scutellar bristles in ♀ short and stout (about one-third so long as those of ♂).

Abdomen.—Dorsum ochraceous-buff, ochraceous, or tawny-ochraceous, longer hair at base of second segment entirely golden-yellow, third to sixth segments inclusive each, as shown in Plate X, with a dark brown more or less lunate mark on each side at base, widely distant from median line but not always extending quite into basal angle, seventh segment and posterior angles of third to sixth segments inclusive yellowish-grey pollinose.

Legs buff; row of bristles at base of front coxae ochraceous, hair clothing front coxae below golden-yellow; femora more or less blotched or streaked with lighter or darker mouse-grey on outer side, front femora similarly infuscated on inside, middle and hind femora flecked with mouse-grey or brownish on outside at distal extremity, middle femora with usual dark brown or brownish blotch on under side near tip; middle tibiae sometimes with a dark blotch on outer side beyond middle, and a trace of a corresponding blotch sometimes visible on hind tibiae also; hind tibiae, and sometimes middle tibiae also, with a faint trace (entirely wanting in some specimens) of a dark brown ring near base; last joint and tip of penultimate joint of middle tarsi mummy-brown, last two joints of hind tarsi clove-brown.

Wings light drab or pale isabella-coloured; veins pale tawny, darker in places, upper portion of anterior transverse vein strongly incassate, anterior transverse vein together with adjacent portion of fourth longitudinal vein lying towards base of wing, as well as

posterior transverse vein and portion of fourth vein immediately beyond, dark brown. *Squamae* semi-hyaline, border buff, fringe pale yellow. *Halteres* cream-buff.

DISTRIBUTION OF *G. longipennis*, Corti.

Glossina longipennis is an East African species, the range of which is apparently somewhat restricted, since up to the present time this Tsetse-fly has been recorded only from Somaliland and the East Africa Protectorate. Since, however, it is found on the line of the Uganda Railway, it is possible that its area also extends into German East Africa, while to the north it perhaps occurs, as Dr. Andrew Balfour has pointed out,* in Southern Abyssinia. Towards its southern boundary the range of *G. longipennis* overlaps that of *G. brevipalpis*, Newst. Whether *G. longipennis* in places where it occurs is found only in small numbers the author is unable to say; in any case, very few specimens of it have so far reached the British Museum (Natural History). The following are the particulars with reference to the nine specimens of this species at present contained in the National Collection.

Somaliland: 3 ♂, 1 ♀, precise locality unknown, 1894 (*Th. Greenfield*). East Africa Protectorate: 1 ♂, ? Kiboko River, or Sabaki River near the confluence of the Tsavo River, 1898 (*the late Vet.-Capt. A. J. Haslam*); 1 ♂, 1 ♀, Uganda Railway (the ♂ taken at Kibwezi Station, "in thorny bush"), 1903 (*Captain E. D. W. Greig, I.M.S.*,—presented by Colonel Sir David Bruce); 1 ♂, Lake Baringo (*Captain R. Ford*); 1 ♀, Uganda Railway, Tsavo River, 6,000 feet, 12. x. 1910, "came into railway carriage at night" (*R. B. Woosnam*).

In addition to the foregoing, the author has also had the opportunity of examining:—1 ♂ (the type of the species), from the River Uelmal, Boran Galla Country, N.-E. Africa, June, 1893 (*Captain Vittorio Bottego*), lent by the Museo Civico di Storia Naturale di Genova, through the courtesy of Dr. R. Gestro; 1 ♀, from West Somaliland, 23–25. vi. 1895 (*C. V. A. Peel*), lent by the University Museum, Oxford, through the kindness of Professor E. B. Poulton, F.R.S.

Brumpt† states that in the Ogaden country, Somaliland, where both the fly and a trypanosomiasis of camels and mules

* Second Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum, p. 31 (1906).

† *Loc. cit.*

disseminated by it are known to the natives by the name "aino," *Glossina longipennis* was the only Tsetse encountered by him from July to October, 1901. A field-note attached to the specimen obtained in West Somaliland by Mr. C. V. A. Peel, as mentioned above, says:—"Fly-belt sharply defined from Biermuddo to Boholo Deno."

BIONOMICS.

No observations on the bionomics of *Glossina longipennis* have yet been placed on record. It may be pointed out, however, that the note attached to the specimen taken by Mr. R. B. Woosman at the Tsavo River, East Africa Protectorate (*vide supra*), shows that the present species, like *G. brevipalpis*, Newst., and *G. pallidipes*, Austen, enters railway carriages on the Uganda Railway.*

PRELIMINARY STAGES.

Not yet observed.

AFFINITIES AND DISTINCTIVE CHARACTERS.

Glossina longipennis, Corti, which belongs to the *Glossina brevipalpis* group, is one of the most easily recognisable of the known Tsetse-flies, since the characteristic and distinctive dark brown spots on the dorsum of the thorax, and the sharply defined brown or dark brown tip to the proboscis bulb suffice to prevent it from being mistaken for any other species of its genus yet described. Further points of difference from *G. brevipalpis* Newst., the only species with which *G. longipennis* can possibly be confused, are mentioned in the diagnosis printed in italics above.

* See also p. 62.

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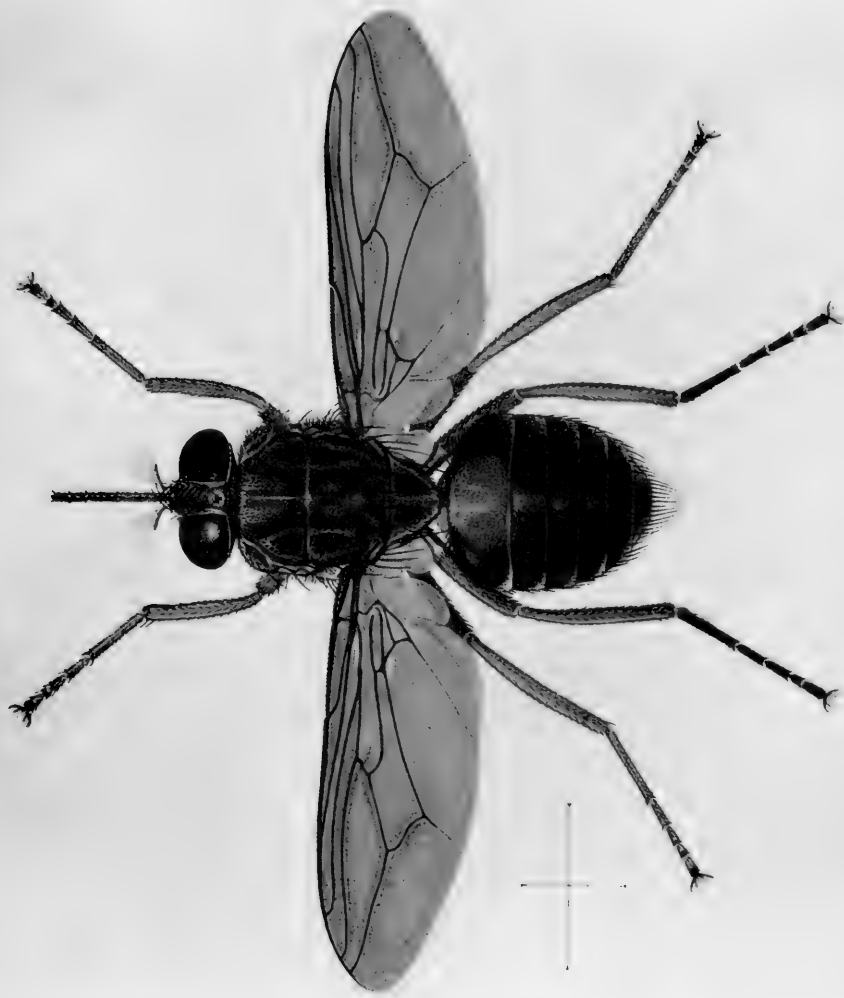
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PL. II. GLOSSINA
CALIGINEA,
Austen. ♀ (× 6).

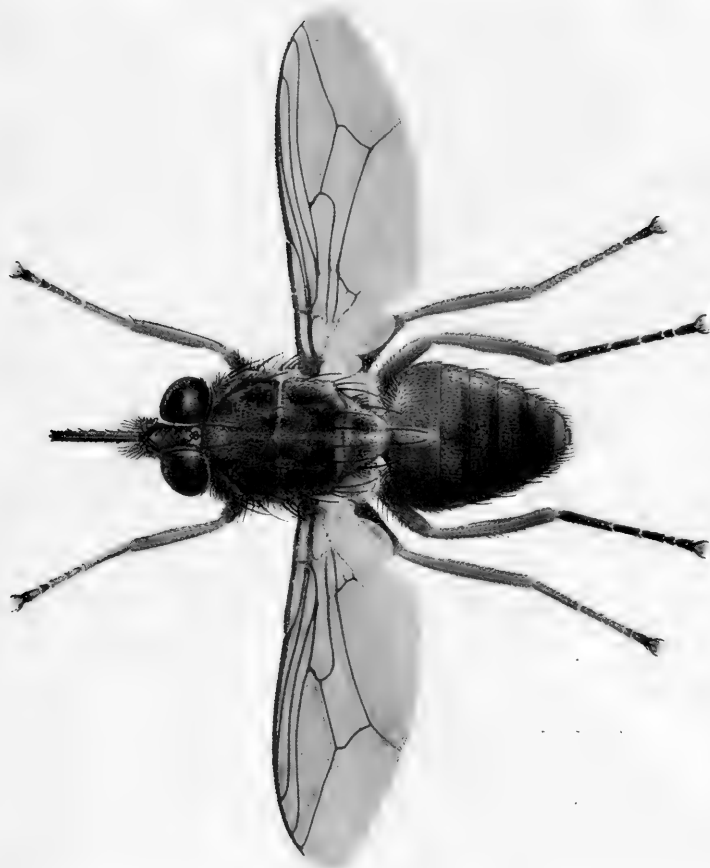


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PL. III. GLOSSINA
PALLICERA,
Bigot. ♂ (× 6).

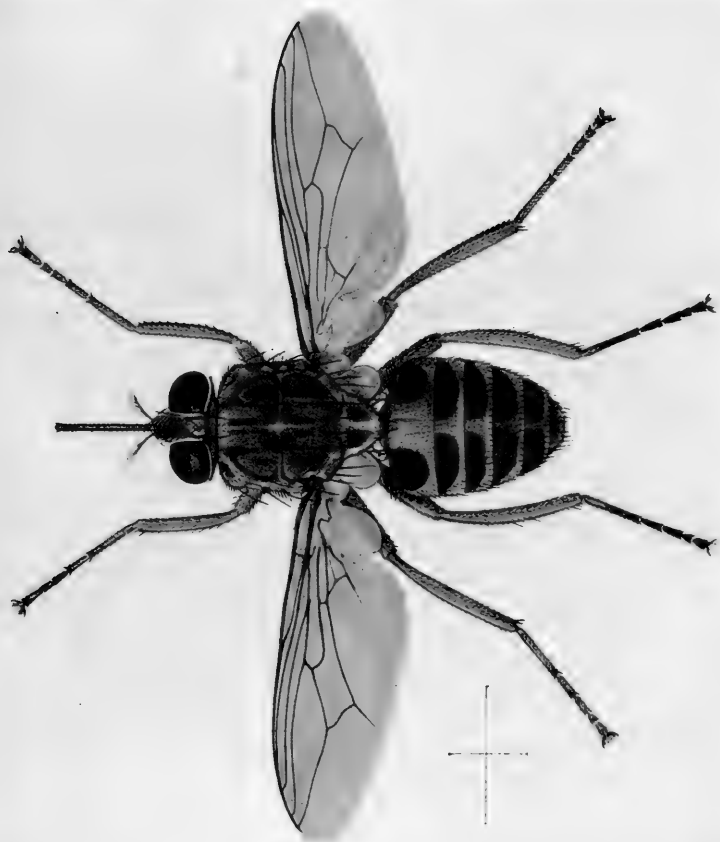


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PL. IV. GLOSSINA
TACHINOIDES,
Westw. ♀ (× 6).



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PI. V. GLOSSINA
MORSITANS,
Westw. ♀ (× 6).



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PI. VI. GLOSSINA
PALLIDIPES,
Austen. ♀ (× 6).



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PI. VII. GLOSSINA
LONGIPALPIS,
Wied. ♂ ($\times 6$).



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PI. IX. GLOSSINA
BREVIPALPIS,
Newst. ♂ ($\times 6$).



PI. X. GLOSSINA
LONGIPENNIS,
Corti. ♀ (× 6).



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